Saskatchewan
Agriculture, Food
and Rural
Revitalization

ADF

AGRICULTURE DEVELOPMENT FUND

FINAL REPORT

20010040

PERFORMANCE AND EFFICIENCY OF FEED UTILIZATION OF PASTURE FINISHED BISON

Funded by: The Agriculture Development Fund

March, 2005

Prepared by: University of Saskatchewan

105-06118/

Performance Efficiency and Feed Utilization of Pasture Finished Bison

Final Report

Project 20010040
27AD

January 2005

Saskatchewan Agricultural Development Fund

Prepared by: Murray Woodbury
Department of Large Animal Clinical Sciences
University of Saskatchewan
Saskatoon, SK S7N 5B4

and

David A. Christensen
Department of Animal and Poultry Science
University of Saskatchewan
Saskatoon, SK S7N 5A8
Email: Christensen@sask.usask.ca

A. Abstract

The objective of this work was to determine the methods used by bison producers to finish bison for market in Saskatchewan. The second objective was to determine the effect of production method on fatty acid composition of bison fat and meat. This work was carried out through a survey and also by collecting tissue samples from 60 bison in Saskatchewan. The fatty acid composition of bison were compared to feedlot finished cattle and sheep. It was found that only 7 percent of producers finished their bison exclusively on forage while the remainder used some level of concentrate feeding. The bison finished on only forage were marketed at 25 months of age whereas those fed concentrate were marketed at an average of 21 months of age. The most noteworthy finding in the fatty acid analysis was that bison contained substantially more long chain unsaturated fatty acids in their rib eye fat than do cattle or sheep. These fatty acids include conjugated linoleic acid and also some of the 20 and 22 carbon unsaturated that may have a favorable impact on human health. The finding of some of these long chained unsaturated was unexpected in that they are normally associated with algae and fish lipids.

B. Executive Summary

The objective of this research was to determine through a survey of bison producers the methods used to finish bison for market in Saskatchewan. A description of production and feeding methods was examined. A primary objective was to determine the carcass characteristics including fatty acid composition and the influence of the method of growing and finishing bison on fatty acid content of the carcass fat and meat.

Through a preliminary survey and contact with the Saskatchewan Bison Association it was found they had 344 members of whom 52 were absentee owners, meaning that their animals were kept at another producers location. This general survey was carried out by contacting 287 producers and a survey questionnaire was designed that was mailed out with a follow-up telephone calls and in some cases personal visits. The survey resulted in a very satisfactory response rate of 83 percent; however under some conditions this type of follow-up survey has been found to generate a 90 percent return rate. Of 286 survey respondents, 170 considered themselves to be mainly involved in production of breeding stock while 116 indicated that they were involved in both production of breeding stock and finishing of bison. The survey accounted for 29,274 bison which is very close to the total bison number for Saskatchewan estimated by Saskatchewan Agriculture Food and Rural Revitalization. Thirty nine percent of the bison in surveyed herds were bred cows, while 35 percent were classified as calves. The remainder consisted of bulls, bred heifers, and open heifers. The survey indicated that 3,694 bison were slaughtered in Saskatchewan in 2002, a dramatic increase from the 1,152 slaughtered in 2000.

When the research project was originally designed it was assumed that a high proportion of the bison sold for slaughter would have been finished on forage. This opinion was based on the general conversations with bison producers. However, the survey found that of 95 producers with good feeding records that only 7 producers finished their bison exclusively on forage while 48 fed grain for less than 90 days, 30 producers fed rations consisting of 50 percent grain and 50 percent forage for more than 90 days and 10 producers finished their bison on high concentrate feed lot rations similar to those used for cattle. It was found that the forage fed bison averaged

25 months of age at slaughter, while those finished on the high concentrate rations were marketed at 21 months. A complete summary of the bison production marketing survey is contained in Appendix B. The mail out survey is contained in Appendix A and this form was also used for follow-up phone calls and personal visits by Tyler Turner. Appendix C contains a powerpoint presentation used by Tyler Turner in a presentation to his M.Sc. committee.

Based on the results of the survey and personal contact with bison producers, Tyler Turner selected a number of producers for provision of carcass information. Mr. Turner was present to take samples from carcasses at slaughter. These carcass samples consisted of rib eye, back fat and kidney fat. Liver samples were also collected and will be analyzed for trace mineral content. The liver samples were used for trace mineral analysis and the other carcass samples were used for detailed fatty acid analysis.

It took over one year to collect tissue samples from 60 bison. Of these 19 were finished mainly on grass, 9 fed concentrate for less than 90 days, 12 fed a 50 percent forage : 50 percent concentrate ration for a lengthy period of time and 12 were finished under feedlot conditions on high concentrate rations. In addition to the 60 bison, 4 feedlot steers from a University of Saskatchewan project were also sampled. These steers were fed a mainly barley grain ration with barley silage as less than 10 percent of the dry matter. In addition 8 sheep were also sampled of which 3 were finished under feedlot conditions, 3 were finished mainly on grass and 2 were finished on high concentrate feeding program which included sunflower seeds. Table 1 contains the combined fatty acid composition of carcass fat taken from the kidney area and back fat areas from all of these animals and table 2 contains similar fatty acid information on fat extracted from a cross section of rib eye muscle from approximately the eleventh and twelfth ribs in bison and cattle. Table 3 contains the kidney and backfat fatty acid composition reported as carcass fat in Tables 2 and 3. The more interesting and significant differences are in bold type.

In examination of the fatty acid data from a human health point of view it is desirable to have relatively low 14:0 and 16:0 fatty acids while 18:0 is neutral in terms of human health. Desirable fatty acids include 18:2 C9, T11 (CLA) and 20:5 (EPA) and 22:6 (DHA). In addition the fatty acid 18:1 C9, (oleic acid) maybe considered beneficial in human health. Of the 14:0 fatty acids (myristic acid) both carcass fat and rib eye fat were relatively low in all groups of animals.

Feedlot steers and sheep finished on grass tended to have the highest values. Palmitic acid (16:0) ranged from 19 to 22 percent in bison with little difference amongst feeding systems. These values are slightly lower than the values for feedlot steers and sheep. The only exception in the sheep were the sunflowers fed group which had slightly lower palmitic acid levels. The bison stearic acid levels (18:0) were all over 30 percent of total fatty acids in bison fat and only about half of that amount in the rib eye fat. Bison carcass fat contained substantially more stearic acid than beef carcass fat. Sheep stearic acid varied considerably from about 20 percent in grass finished steers to over 30 percent in those being fed sunflower seed. Bison carcass fat contained slightly less linoleic acid (18:1) than beef carcass fat or sheep carcass fat. The rib eye linoleic acids in bison were all in the range of 30 percent with a slightly higher value for feedlot bison. These bison values were similar to the 34 percent linoleic acid found in beef rib eye. Linoleic acid in sheep rib eye fat was considerably higher in feedlot fed sheep compared to those fed with sunflower seed. Rib eye fat contains substantially more linoleic acid (18:2) than carcass fat in all bison, beef, and sheep samples compared to carcass fat. Linoleic acid tended to be higher in bison rib eye fat than in feedlot beef or the feedlot or grass fed sheep. However, substantially higher levels of linoleic acid were found in rib eye fat of sunflower seed fed sheep. The CLA content of bison carcass and rib eye fat were all lower than 0.5 percent of fatty acids and in most cases closer to 0.25 percent. Feedlot steer CLA rib eye and carcass contents differed greatly from those of bison. The only notably higher CLA content was found in grass fed sheep for both carcass fat and rib eye fat at slightly over 1 percent of fatty acids. Carcass fat content of longer chained fatty acids such as 22:1 (Erucic acid), 20:5 (EPA), and 22:6 (DHA) were very close to 0 for all carcass fat samples from bison, beef, and sheep. However, significant amounts of EPA (1.2 percent) were found in the rib eye of grass finished bison with levels of about half of that amount in the other bison groups. Feedlot beef rib eye fat contained a very low level of EPA and only the grass and sunflower fed sheep contained close 0.4 to 0.45 percent EPA. The finding of EPA in bison fat is of considerable interest as it is normally found in only algae and fish fat. Similarly small, but measurable amounts of DHA were found in rib eye fat from grass fed bison with substantially lower levels in all other groups.

Fatty acids in chain length up to carbon 16 are mainly from newly synthesized fatty acids in the body, whereas fatty acids longer than 16 carbons are derived from some combination of feed and carcass fat. It is not surprising that there are very low levels of fatty acids longer than C18 with

more than 2 unsaturated bonds in carcass fat. However, it is notable that rib eye fat, especially in bison contained significant amounts of several of the long chain unsaturated fatty acids. This would indicate that there may be a different microbial population in bison, or there may be different metabolic pathways in liver or other tissue resulting in some of these nutritionally interesting long chain unsaturated fatty acids. The presence of these fatty acids is a positive factor in the nutritional and health significance of bison rib eye meat.

C. Technical Report

The objective of this research was to determine by means of a survey the methods used to finish bison for market in Saskatchewan. A second objective was to determine the carcass fatty acid composition of bison fat and meat and the influence of method of growing and finishing bison on fatty acid content. This work was carried out initially through the use of the survey described in Appendix A and the results of this survey are summarized in Appendix B. The initial telephone survey involved contacting 344 Saskatchewan Bison Association members by telephone. It was originally assumed that a high proportion of the bison sold for slaughter would have been finished on forage. However through the survey it was found that of 95 producers with good feeding records only 7 producers finished their bison exclusively on forage while the remainder used various levels of concentrate feeding for at least 90 days. Carcass fat and rib eye samples were taken for detailed fatty acid analysis. Out of this phase of the work involved a great deal of time in method verification to identify all 34 measurable and identifiable fatty acids. This is one of the most comprehensive and detailed analyses of bison fatty acid composition that has been undertaken. The results of these analyses are presented in Table 1, 2 and 3. This data will be used as a major part of Tyler Turner's M.Sc. thesis and research. Further statistical analyses are in Tables 4 to 6. Further interpretation will be included in Mr. Turner's thesis and a copy of the thesis will be provided as a supplement to this report. The most notable finding in the fatty acid analysis was the higher content of long chain unsaturated fatty acids in the rib eye fat of bison compared to beef and sheep. We are not aware of this finding has been previously reported. It may be of benefit to the bison industry to have follow-up studies in which bison are fed long chain fatty acids such as those found in flax, sunflower seed, or canola in order to determine the effect of diet on meat fatty acid composition under more controlled conditions.

Mr. Turner has prepared a powerpoint presentation summarizing the survey and this is included in the technical report as Appendix C. Mr. Turner is in the process of preparing a poster to summarize his results which will be used in College of Agriculture displays and also for general public viewing.

The information in this report indicates that the fatty acid composition of bison meat has a number of desirable characteristics particularly the long chain fatty acids which were mentioned. This includes conjugated linoleic acid (CLA); however the feedlot finished bison contained only about half of the CLA contained in the grass finished bison in the back fat.

As shown in Table 1, beef carcass fat contains much more myristic acid than bison fat. However, bison fat contains much higher levels of stearic acid than beef fat. It appears that beef is desaturated to form 18:1 forms of oleic acid to a greater extent than occurs in bison. This is shown by the high 18 desaturase ratio for steers.

Table 2 shows that bison rib-eye fat contains substantial amounts of long chain unsaturated fatty acids. Arachidonic acid, the precursor to prostaglandins, is almost three times the level found in beef. Likewise, EPA, DPA and DHA are all higher in bison meat than in beef.

In Table 3 it is shown that there are differences between kidney fat and backfat. For example, oleic acid is higher in backfat than kidney fat in all groups.

Tables 4, 5 and 6 show statistically significant differences at the 5% probability level. One of the most noteworthy differences are the higher and substantial levels of long chain unsaturates of the omega-3 family in bison meat fat of forage finished animals.

D. Personnel

Tyler Turner has been fully funded as a graduate student from this project. Technical assistance was also provided by Ananda Samaraweera and Neil Webb.

E. Equipment

No equipment has been purchased for more than $1,000.00.

F. Project Development Materials

A copy of the poster now under development will be provided along with a copy of Tyler Turner's M.Sc. thesis when it is completed.

G. Project Photos

A substantial photo gallery has been collected, several examples are included as powerpoint slides in this report.

H. Acknowledgement

In Contact With the Saskatchewan Bison Association and Individual Producers support from the Saskatchewan Agriculture Development Fund has been recognized and this acknowledgement will be carried forward in the poster and Mr. Turner's M.Sc. thesis.

Summary of Bison Production and Marketing Survey

In the beginning when the objectives of the project were outlined, it was unclear which producers would be involved. An initial screening interview was conducted over the telephone in the fall of 2001. The Saskatchewan Bison Association office provided a membership list of all the current Saskatchewan Bison Association (SBA) members along with their telephone numbers. All institutes which held SBA memberships, such as the Western Canadian Agribition, were excluded by the SBA. Other members who resided outside Saskatchewan were excluded prior to initiation of the phone survey. Exclusion of SBA members from the phone survey was done so in an effort to cut costs and to speed up the surveying process.

The telephone survey was designed to identify those producers who are raising breeding stock and those who are finishing animals for the meat market. The telephone interview also served to identify myself to the producers and to make them aware of the current research being undertaken at the University of Saskatchewan. Dillman (1978) stated that by preceding a mail questionnaire with a telephone interview creates a friendly rapport with the respondents as they answer the questions and paves the way for the follow-up mail questionnaire.

The telephone survey phase commenced on October 15th of 2001 and lasted till January 9th of 2002. During this time 344 SBA members were contacted. As found in numerous other telephone based surveys, an increasing number of callbacks are now required to reach the occupants of sampled households (Dillman, 1978). Numerous attempts were made in contacting many of the SBA members due to occupants' presents at the time of the call, knowledge of farm operations, and time available to answer questions. Of the 344 members contacted, 52 were absentee owners, which means their animals were kept at another producer's place. The animals owned by the absentee owners were included in the farm census of where the animals were kept at the time of the survey. Four producers did not feel that participation in the survey would be beneficial to them, therefore they refused to participate. This left a total of 287 producers out of 344 who contributed information to the survey. Participation in the survey resulted in a response rate of 83%, which is below the average of 91% when using the Total Design Method (TDM)

(Dillman 2000). Findings from the phone survey indicate that almost half of bison producers (fig. 1) consider themselves to be involved in finishing bison for the meat market. A tally of animals in the breeding herd indicated that there were 29,274 animals currently in Saskatchewan. This summation does not include bulls that were designated to be finished as carcass animals. The break down of breeding herd animals collected from the phone survey is illustrated in Figure 2.

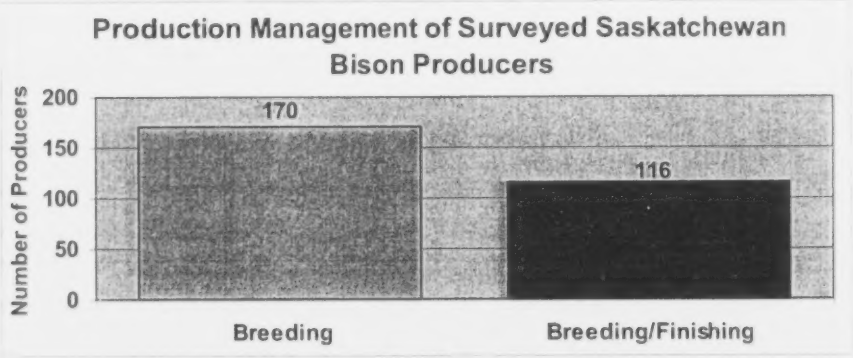


Figure 1. The division of participating bison producers in Saskatchewan based on results obtained from the phone survey according to producer operation.

The number of bison, which were accounted for in the survey, was very close to the estimates made by Saskatchewan Agriculture and Food (SAF). In October of 2001 a nation wide survey estimated the number of bison in Saskatchewan to be 30,000 (SAF 2001). The number of bison slaughtered from Saskatchewan during 2000 and 2001 (fig.3) indicate a 63% increase in bison produced for the meat market. The dramatic jump in the number of bison produced for the meat industry in 2002 (fig 3) may be reflective in the drop in value of breeding stock. With fewer animals being sold as herd sires, there would be a surplus of animals which would need an alternative market destination.

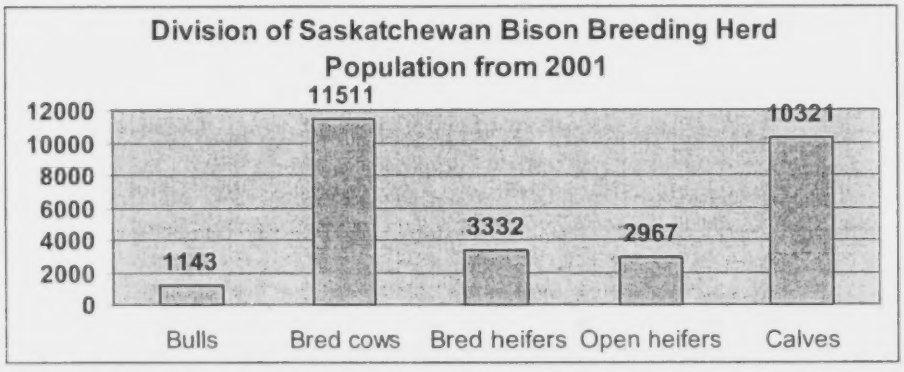


Figure 2. Census results of bison in breeding herds in Saskatchewan based on numbers collected during the phone survey.

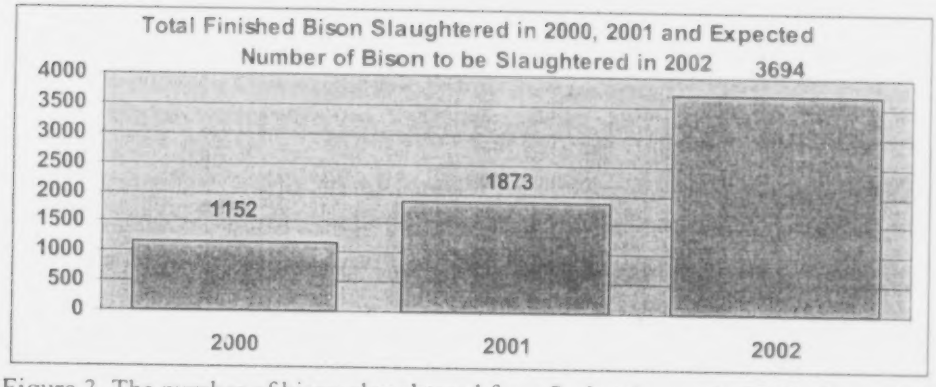


Figure 3. The number of bison slaughtered from Saskatchewan in 2000, the number of bison destined to be slaughtered in 2001 and the expected number of bison to be slaughtered in 2002

Once the phone survey was complete, the responding producers that are finishing bison as meat animals were separated for further analysis. The 116 producers that consider themselves to be finishing animals was further sorted in to those which finished animals in 2001. The 95 producers who had established finishing practices in 2001 were divided into respective finishing groups as defined by the project. It is evident from the number of producers representing each of the finishing groups (fig 4) that growing bison on grass till 90 days prior to slaughter then switching them to a high energy concentrate diet is the most popular finishing program in Saskatchewan in 2001.

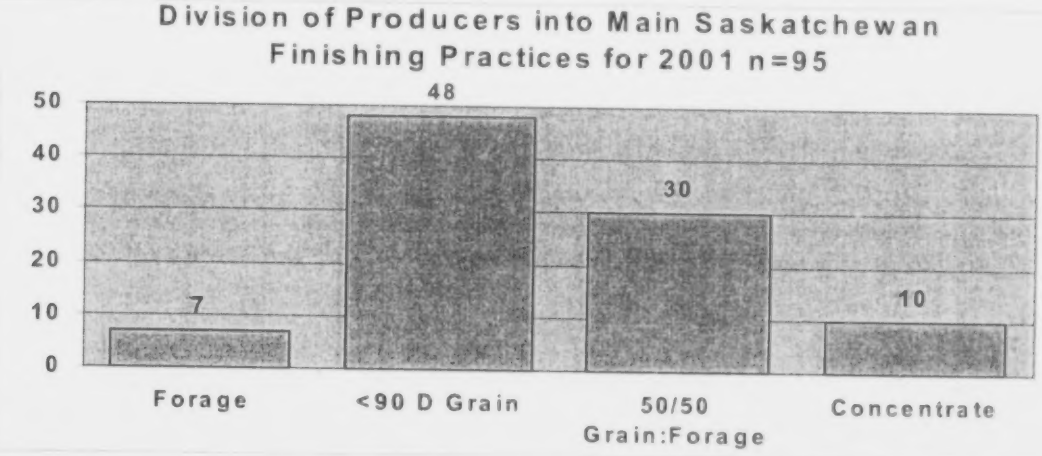


Figure 4 Bison producers finishing bison in Saskatchewan in 2001, divided into common finishing programs.

The percent of producers (fig 5) representing the portion of total finishing operations conducted during 2001 indicate that <90 days on grain makes up half of the total finishing operations.

(Dillman 2000). Findings from the phone survey indicate that almost half of bison producers (fig. 1) consider themselves to be involved in finishing bison for the meat market. A tally of animals in the breeding herd indicated that there were 29,274 animals currently in Saskatchewan. This summation does not include bulls that were designated to be finished as carcass animals. The break down of breeding herd animals collected from the phone survey is illustrated in Figure 2.

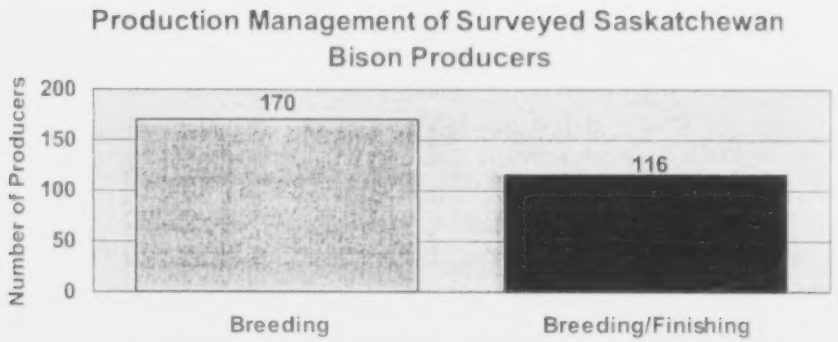


Figure 1. The division of participating bison producers in Saskatchewan based on results obtained from the phone survey according to producer operation.

The number of bison, which were accounted for in the survey, was very close to the estimates made by Saskatchewan Agriculture and Food (SAF). In October of 2001 a nation wide survey estimated the number of bison in Saskatchewan to be 30,000 (SAF 2001). The number of bison slaughtered from Saskatchewan during 2000 and 2001 (fig.3) indicate a 63% increase in bison produced for the meat market. The dramatic jump in the number of bison produced for the meat industry in 2002 (fig 3) may be reflective in the drop in value of breeding stock. With fewer animals being sold as herd sires, there would be a surplus of animals which would need an alternative market destination.

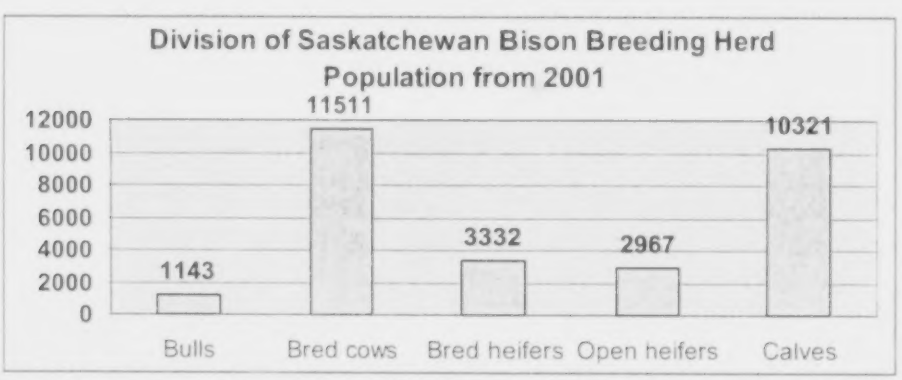


Figure 2. Census results of bison in breeding herds in Saskatchewan based on numbers collected during the phone survey.

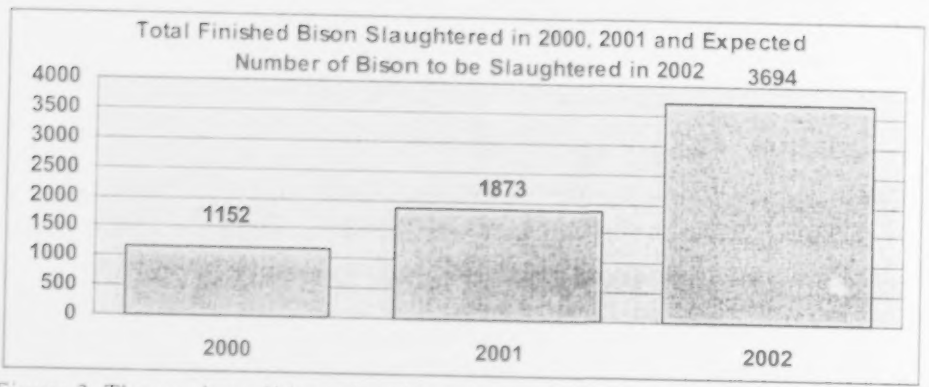


Figure 3. The number of bison slaughtered from Saskatchewan in 2000, the number of bison destined to be slaughtered in 2001 and the expected number of bison to be slaughtered in 2002

Once the phone survey was complete, the responding producers that are finishing bison as meat animals were separated for further analysis. The 116 producers that consider themselves to be finishing animals was further sorted in to those which finished animals in 2001. The 95 producers who had established finishing practices in 2001 were divided into respective finishing groups as defined by the project. It is evident from the number of producers representing each of the finishing groups (fig 4) that growing bison on grass till 90 days prior to slaughter then switching them to a high energy concentrate diet is the most popular finishing program in Saskatchewan in 2001.

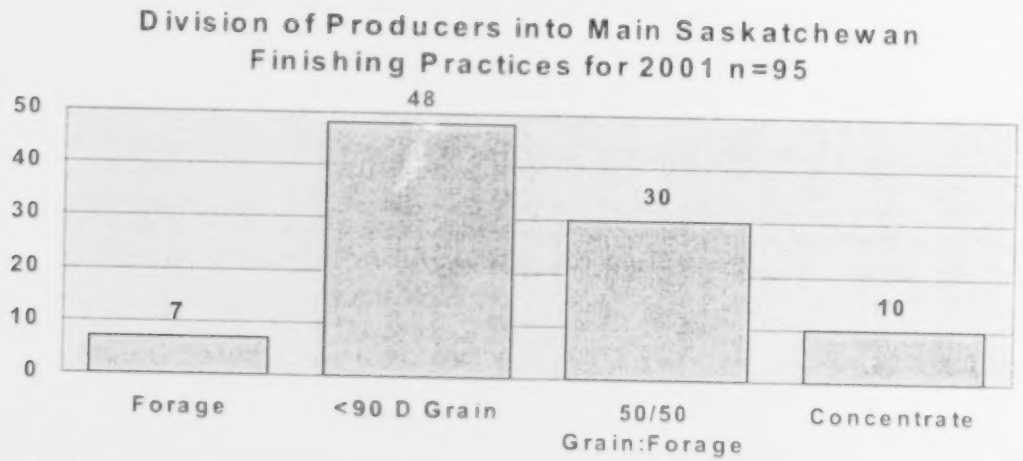


Figure 4 Bison producers finishing bison in Saskatchewan in 2001, divided into common finishing programs.

The percent of producers (fig 5) representing the portion of total finishing operations conducted during 2001 indicate that <90 days on grain makes up half of the total finishing operations.

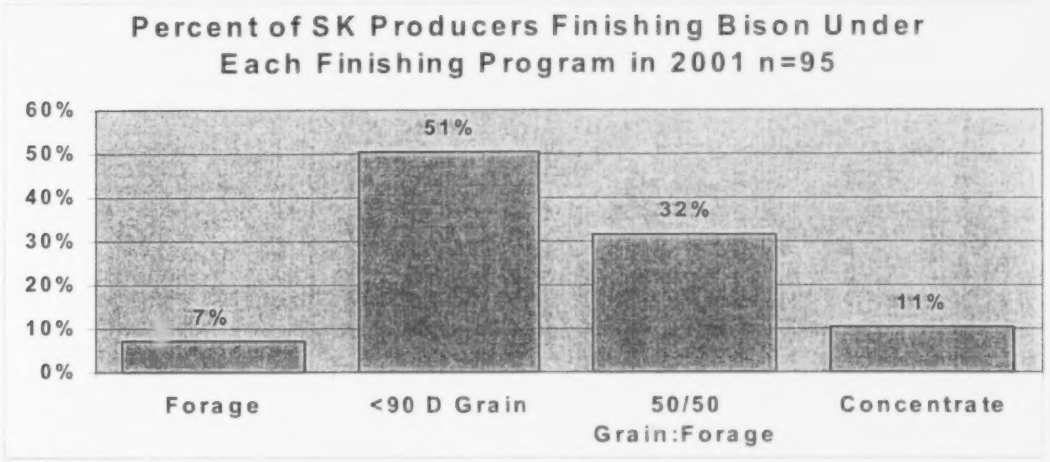


Figure 5 Percent of total finishing producers represented in each of the four main finishing programs of bison finishing operations in Saskatchewan for 2001.

The number of bison finished under each of the four main finishing categories (fig 6) are not very representative of the portion of producers using each program. The largest discrepancy between the number of producers involved and the number of bison produced comes from the strictly Forage finished class. The Forage class represents 7% of all finishing producers in Saskatchewan. If each producer operation were on an equal scale, it would be expected to see 130 of the 1852 animals to be finished under strictly forage feeding conditions instead of the quoted 24. The largest underestimation of the number of bison produced from one finishing class comes from the <90 D Grain group. In this group an expected 944 animals should have been produced in 2001. However, the phone survey indicated that there were 1158 animals finished in this manner.

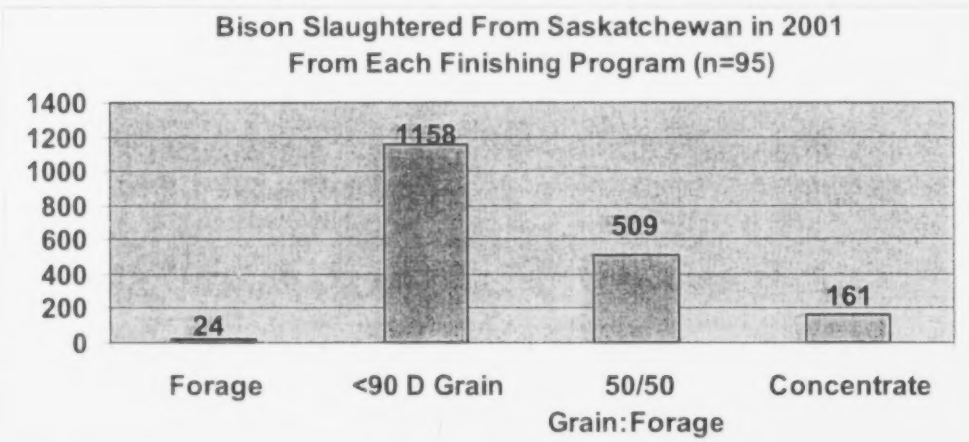


Figure 6 Number of bison finished under each feeding program during 2001 that there were 1158 animals produced from this finishing class in 2001.

Inferences made from these two charts would indicate that the Forage finishing class is made up of smaller scale producers, and that <90 D Grain operations tend to be larger on average.

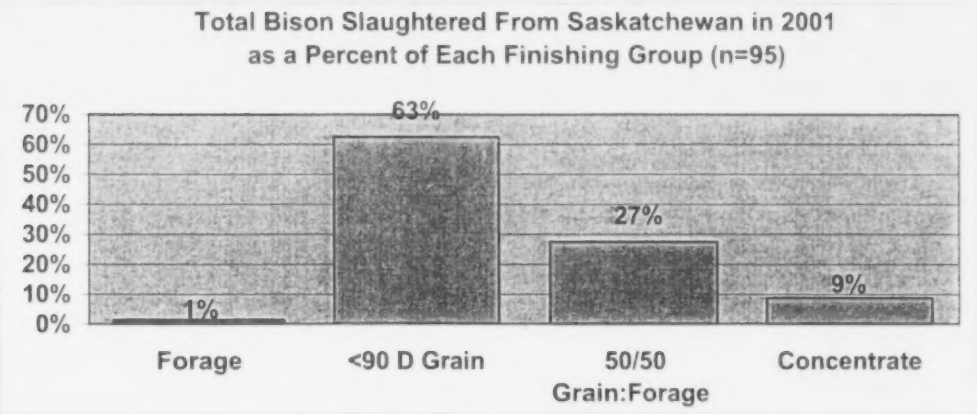


Figure 7 The percent of bison slaughtered from each of the main finishing programs found in Saskatchewan in 2001, n=95

A more accurate depiction of how much influence each of the finishing programs has of the number of animals being finished under each of the finishing programs is offered in figure 7 where slaughter numbers are represented from each class as a percentage of the total number of bison slaughtered.

In an effort to gain an understanding of finishing conditions here in Saskatchewan, finishing producers were polled to find out the length of time that it takes to finish a bison from birth to slaughter. The difference between each of the finishing programs was minimal. However a general trend (fig 8) relating to the length of time the animals are fed concentrate and the time period required to finish the animals is evident. The time taken to finish the animals is inversely related to the amount of concentrate the animals are fed.

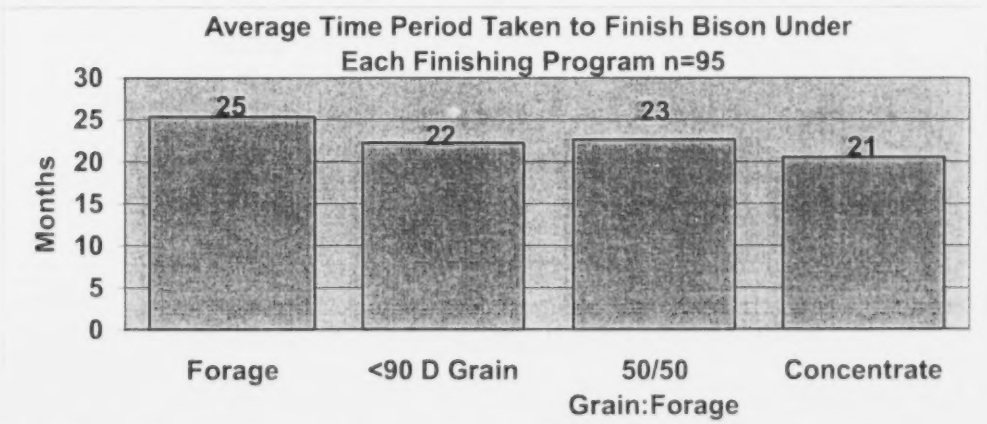


Figure 8 The estimated time taken to finish bison under each of the four different finishing programs.

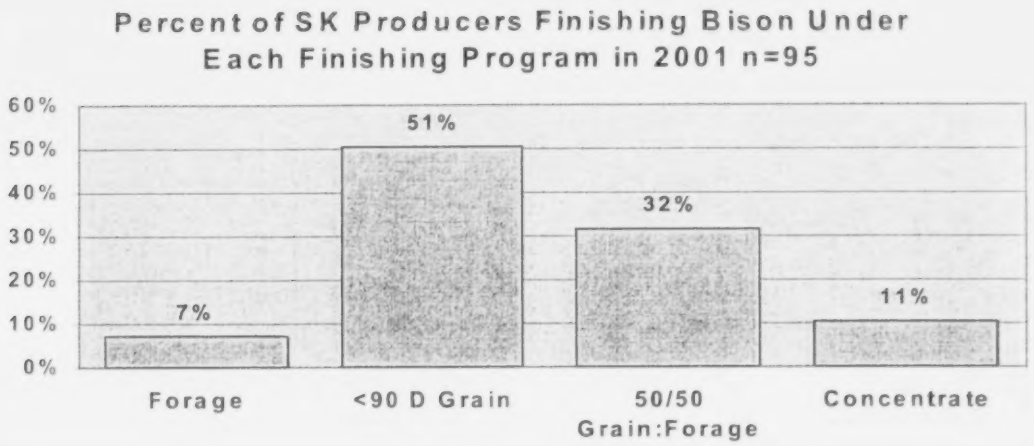


Figure 5 Percent of total finishing producers represented in each of the four main finishing programs of bison finishing operations in Saskatchewan for 2001.

The number of bison finished under each of the four main finishing categories (fig 6) are not very representative of the portion of producers using each program. The largest discrepancy between the number of producers involved and the number of bison produced comes from the strictly Forage finished class. The Forage class represents 7% of all finishing producers in Saskatchewan. If each producer operation were on an equal scale, it would be expected to see 130 of the 1852 animals to be finished under strictly forage feeding conditions instead of the quoted 24. The largest underestimation of the number of bison produced from one finishing class comes from the <90 D Grain group. In this group an expected 944 animals should have been produced in 2001. However, the phone survey indicated that there were 1158 animals finished in this manner.

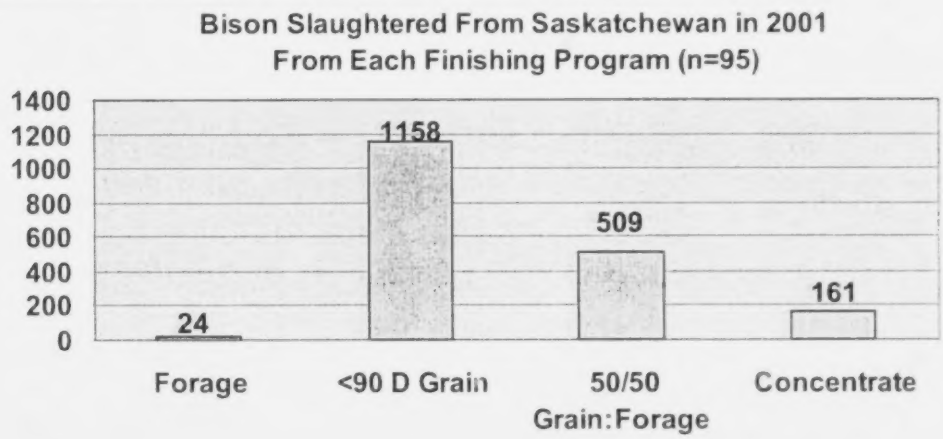


Figure 6 Number of bison finished under each feeding program during 2001 that there were 1158 animals produced from this finishing class in 2001.

Inferences made from these two charts would indicate that the Forage finishing class is made up of smaller scale producers, and that <90 D Grain operations tend to be larger on average.

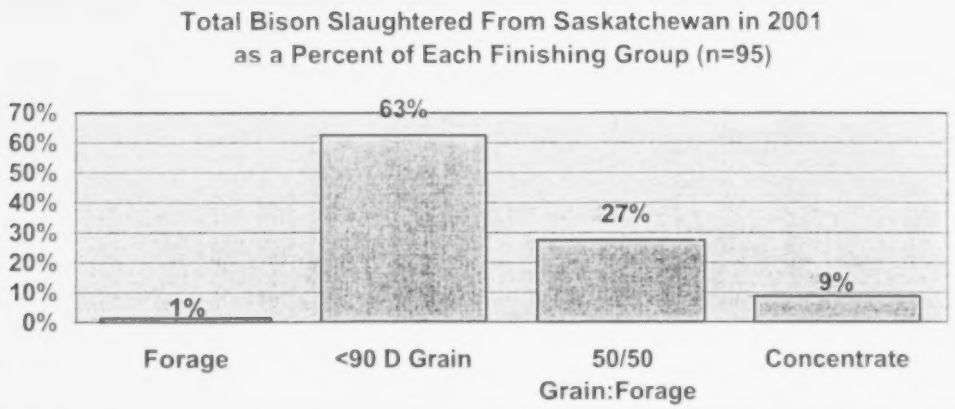


Figure 7 The percent of bison slaughtered from each of the main finishing programs found in Saskatchewan in 2001, n=95

A more accurate depiction of how much influence each of the finishing programs has of the number of animals being finished under each of the finishing programs is offered in figure 7 where slaughter numbers are represented from each class as a percentage of the total number of bison slaughtered.

In an effort to gain an understanding of finishing conditions here in Saskatchewan, finishing producers were polled to find out the length of time that it takes to finish a bison from birth to slaughter. The difference between each of the finishing programs was minimal. However a general trend (fig 8) relating to the length of time the animals are fed concentrate and the time period required to finish the animals is evident. The time taken to finish the animals is inversely related to the amount of concentrate the animals are fed.

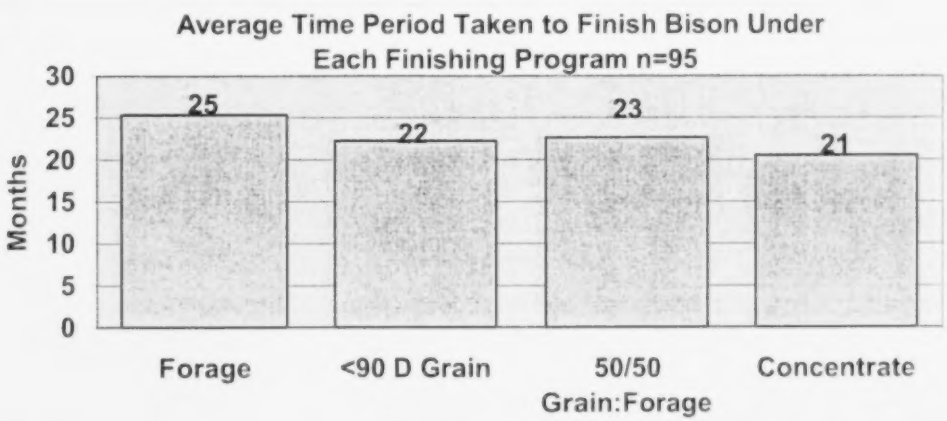


Figure 8 The estimated time taken to finish bison under each of the four different finishing programs.

In order to focus on those producers, who make significant contributions to the domestic bison meat production in Saskatchewan, the data was sorted to exclude those producers who finished <10 bison in 2001. Sorting of the data revealed that there were only 52 producers who were finishing 10 or more animals in 2001 for the finished market. This group was further sorted to remove producers who were not willing to fill out the pending mail survey, further reducing the number to 46 producers. Prior telephone calls to screen likely participants increased the probability of completion of following surveys (Dillman, 1978). Analysis of the 46 selected producers indicated that feeding bison for <90 days on grain prior to slaughter was still the most popular form of finishing (fig.9).

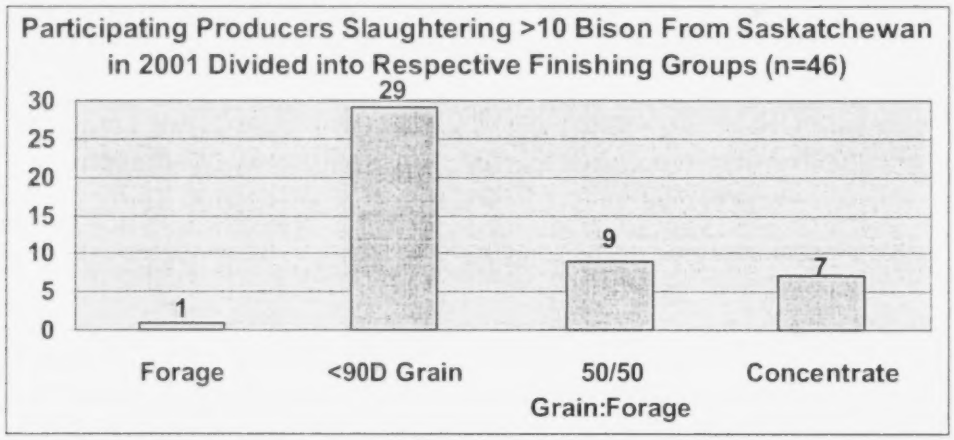


Figure 9 Number of participating producers segregated by preferred finishing program

The percentage of participating producers representing each of the finishing classes (fig. 10) is representative of the survey results of the original 95 producers. With the willing participants representing each of the main finishing categories, and being proportional to the total surveyed respondents, the mail survey should be successful using these 46 producers.

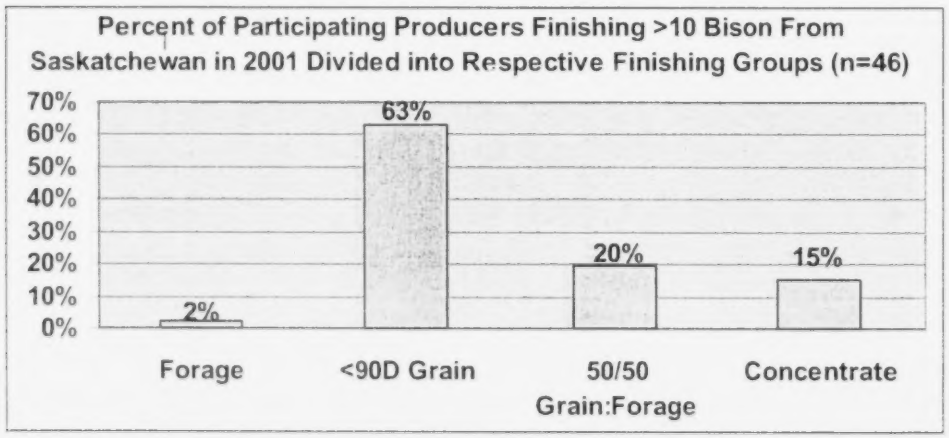


Figure 10 Participating producers expressed as the percentage of producers representing each finishing program

In order to focus on those producers, who make significant contributions to the domestic bison meat production in Saskatchewan, the data was sorted to exclude those producers who finished <10 bison in 2001. Sorting of the data revealed that there were only 52 producers who were finishing 10 or more animals in 2001 for the finished market. This group was further sorted to remove producers who were not willing to fill out the pending mail survey, further reducing the number to 46 producers. Prior telephone calls to screen likely participants increased the probability of completion of following surveys (Dillman, 1978). Analysis of the 46 selected producers indicated that feeding bison for <90 days on grain prior to slaughter was still the most popular form of finishing (fig.9).

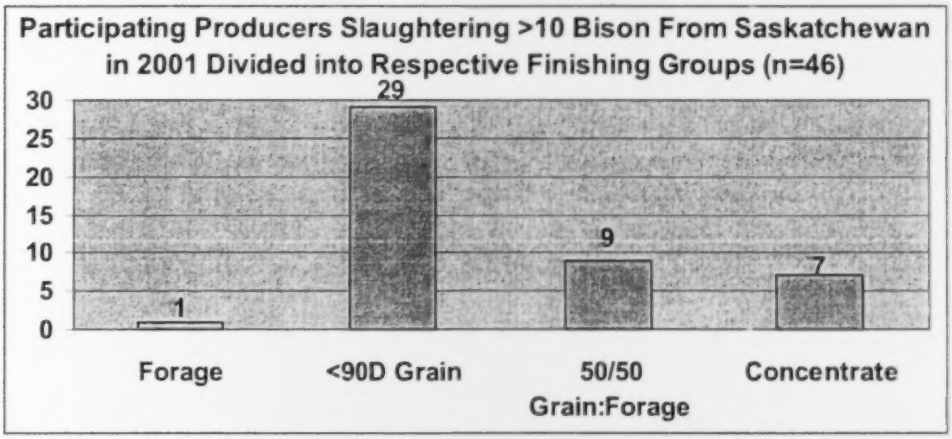


Figure 9 Number of participating producers segregated by preferred finishing program

The percentage of participating producers representing each of the finishing classes (fig. 10) is representative of the survey results of the original 95 producers. With the willing participants representing each of the main finishing categories, and being proportional to the total surveyed respondents, the mail survey should be successful using these 46 producers.

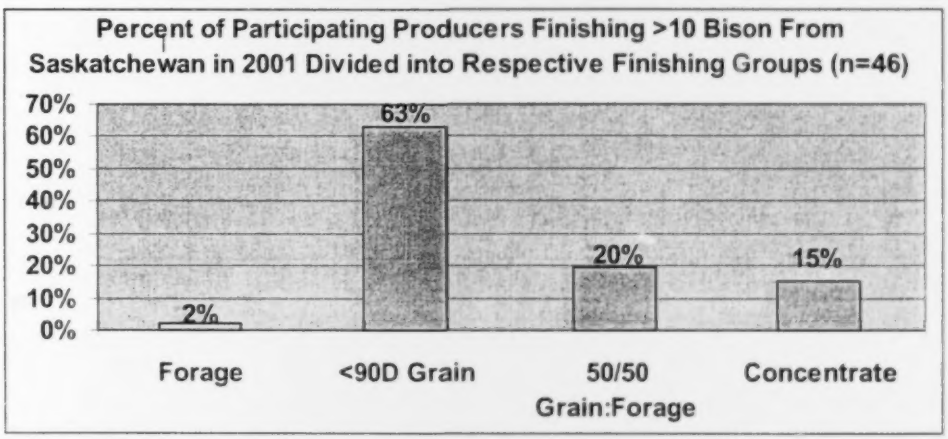


Figure 10 Participating producers expressed as the percentage of producers representing each finishing program

Once the initial screening process was complete, it became apparent that the forage finishing group was under represented. In an effort to establish a more representative response of the forage finishing group, outside province producers were sought out. Searches were conducted amongst producers in Alberta and Manitoba. A single strictly forage finishing producer was contacted and included in the mail survey.

The Mail Survey

The key to maximizing survey responses is to, maximize the rewards for co.npleting the survey, minimize the costs of responding, and establish trust that those rewards will be delivered (Dillman, 1978). The mail survey was designed to minimize the effort required by the respondent. The success of the survey was ensured by a number of different phases, from the design stage to the follow up calls.

The first step was to select respondents who voiced an interest in our study during the phone survey. These were typically producers who were finishing more than 10 bison per year. These 46 producers operations also covered the spectrum of finishing operations of interest for the fatty acid study (fig 10). An extra forage finishing producer was sought out in order to add some diversity to the forage finishing group, bringing the total number of mail survey participants up to 47. The second stage was to design a cover letter that outlined the steps involved with the selection and collection of samples from the producers. Personalizing the survey to each respondent via, individual salutations, real signatures and expressing that they are part of an distinguished group are all ways in which to elicit a positive feeling from the respondent thus increasing the return rate (Dillman, 1978). When conducting a survey it is also important to establish a sense of trust between the respondent and the interviewer, in order to maximize the return rate (Dillman, 1978). Although there were no physical rewards offered for participating in the study, the incentive to complete the questionnaire as quickly as possible was present. In order to increase response rate, a sense of legitimacy and authority of the survey was established as suggested by Dillman (2000). This was accomplished by emphasizing that this was a joint project between the Western College of Veterinarian Medicine's Specialty Livestock department and the University of Saskatchewan's Department of Animal and Poultry Science. In order to encourage the producer's eager participation, their value to the project was expressed. Another reward to the producers was to inform the producers that the end results from this project would provide all bison producers with a marketing tool which reemphasizes the health benefits of bison meat.

Various efforts were undertaken in order to reduce the cost participants would associate with completing the questionnaire. A postage paid return envelope was included in the questionnaire package sent to each selected producer. The presence of a stamped return envelope has been documented to improve the response rate (Dillman 2000). Other efforts to reduce the cost of participating in the survey were to limit the length of the survey and difficulty of the questions. All efforts to make questionnaires clear and concise thereby making them less formidable in appearance have been shown to increase respondent participation (Dillman. 1978).

The mail out questionnaire has the advantage, over other survey methods, by allowing participants to take their time in answering the questions. The extra time allowed for completion of the questionnaire helps to ensure more accuracy by the respondent for the questions asked

(McCallon and McCray 1975). A closed ended and partially closed-ended questioning format was chosen for most of the questionnaire. A majority of the questions had a list of answers in which the respondent could chose from. A partially closed-ended format was necessary when referring to the feeding practices of the producers. Partially closed-ended questions are necessary if there is a possibility that certain options may be overlooked (Woodward and Chambers, 1983). There were a number of questions in which the producer needed to provide their own response. These open-ended questions were included being that the responses would have been too numerous to attempt to include all possible answers. A uniform questionnaire in which all respondents receive the exactly same phrased questions will yield data which is more comparable than data obtained through other survey methods (McCallon and McCray 1975). Although not the entire questionnaire was closed-ended, it was structured enough in that responses were comparable. When wording the questions, an effort was made to reduce the number of syllables in the words used in order to make the questionnaire appear less intimidating as recommended by Converse and Presser (1986).

In order to make the survey more appealing to the respondents thus increasing the return rate, the recommendations of Long (1998) were taken into account. Recommendations include mixing up the degree of difficulty of the questions so that the participant does not become over stressed with the questionnaire as well as placing the most important questions near the middle of the survey (Long 1998).
The overall success of a survey is determined by the significance of the responses received and by the percent of questionnaires returned.
The percentage of return depends upon such factors as the length of the questionnaire, the reputation of the sponsoring agency, the complexity of the questions asked, the relative importance of the study as judged by the potential respondent, the extent to which the respondent believes his responses to be important, and the quality and design of the questionnaire itself. (McCallon and McCray 1975).

The expected response rate to a properly conducted survey using the Total Design Method should be expected to average about 77% (Dillman 2000). These finding concur with those found by Linsky (1975), that pre-contact with the respondent through a phone survey will increase the response rate. In the survey review by Linsky (1975), he showed that the response rate to the questionnaire jumped from 21% to 68% when respondents were informed prior to the arrival of the impending questionnaire. The initial phone survey served a two-fold purpose, one to introduce the study to the producers and another to screen for potential participants.

Research has shown that follow up calls by telephone are an effective method of prodding the return of mail questionnaires (Dillman, 1978). Two weeks after the initial mail-out date, 11 questionnaires had been returned. Because it was important for the remainder of the study of fatty acids, all efforts were made to maintain a friendly interaction with the participating producers. This was encouraged through personal telephone calls to the producers to remind them to complete the survey and to answer any questions they had. In this particular survey, follow up calls were placed three weeks after the initial questionnaire was mailed out. This first round of follow up calls began on March 25th resulted in one survey needing to be re-mailed due to the survey being misplaced by respondent. Multiple attempts to contact potential respondents are essential to increase the return rate (Dillman 2000). As of April 26th 28 of the 46 questionnaires had been returned, increasing the return rate from 24% at two weeks to 61% by six weeks. A second round of follow up calls was commenced on April 26th resulting in two

more surveys needing to be re-mailed due to miss placement. Six more questionnaires were received prior to the third round of follow up calls, which commenced on May 14th. By May 24th a total of 39 questionnaires had been received. Brief review of the responces showed that the original producer identified as finishing animals strictly on forage was one of the producers who had switched finishing programs. At this point the search for a replacement forage finishing producer was initiated. Once one was located and his response recorded, the total number of responses to the mail questionnaire was 40 (fig 11) raising the total return rate to 85%. This by far exceeds the expectations of Dillman for a successful return rate of a mail questionnaire.

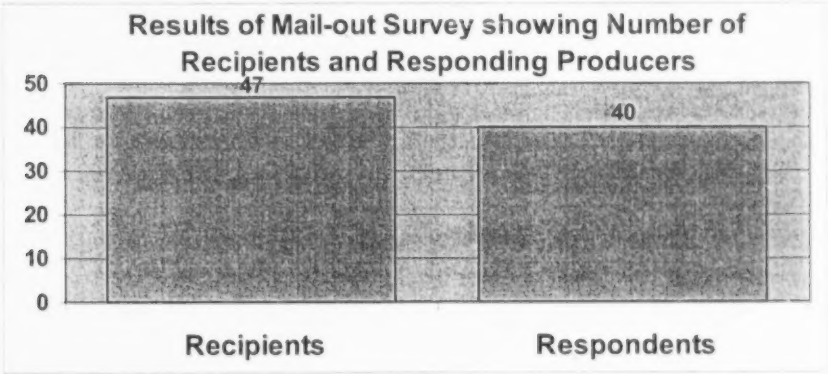


Figure 11 Return rate of the mail out questionnaire had a success rate of 40 of the 47 mail outs being returned or a 85% return rate

Further communications with the producers were commenced in order to clarify some of the responses that were received from the survey. By this point, of the 47 producers contacted (fig 12), 7 did not respond, 4 responded but had sold their animals from the 2001 calving season, leaving the remaining 36 or 77% of the original producers in which to complete the fatty acid study with (fig 13).

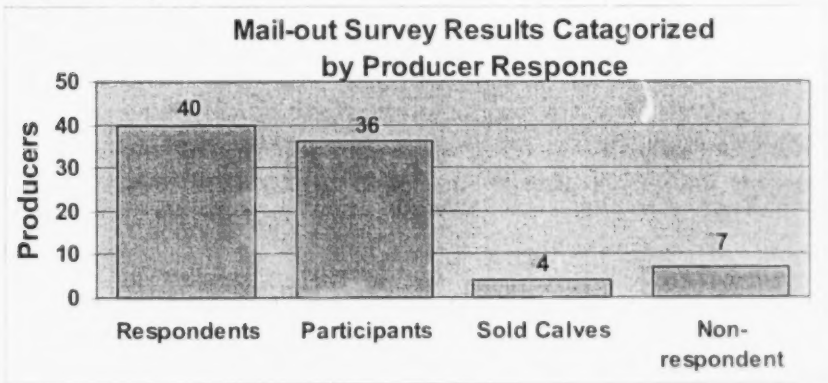


Figure 12 Categorization of producer reaction to the mail out questionnaire

more surveys needing to be re-mailed due to miss placement. Six more questionnaires were received prior to the third round of follow up calls, which commenced on May 14th. By May 24th a total of 39 questionnaires had been received. Brief review of the responces showed that the original producer identified as finishing animals strictly on forage was one of the producers who had switched finishing programs. At this point the search for a replacement forage finishing producer was initiated. Once one was located and his response recorded, the total number of responses to the mail questionnaire was 40 (fig 11) raising the total return rate to 85%. This by far exceeds the expectations of Dillman for a successful return rate of a mail questionnaire.

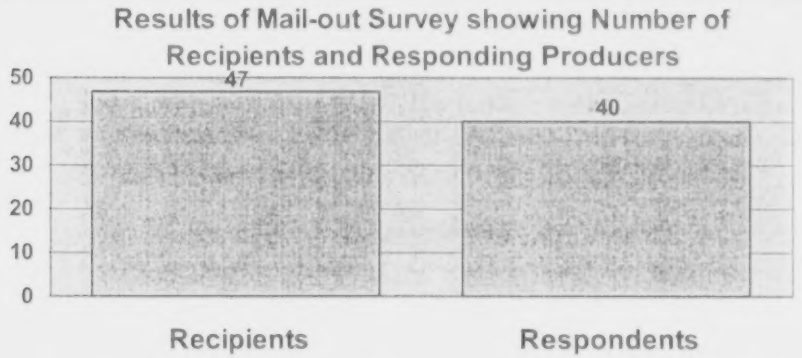


Figure 11 Return rate of the mail out questionnaire had a success rate of 40 of the 47 mail outs being returned or a 85% return rate

Further communications with the producers were commenced in order to clarify some of the responses that were received from the survey. By this point, of the 47 producers contacted (fig 12), 7 did not respond, 4 responded but had sold their animals from the 2001 calving season, leaving the remaining 36 or 77% of the original producers in which to complete the fatty acid study with (fig 13).

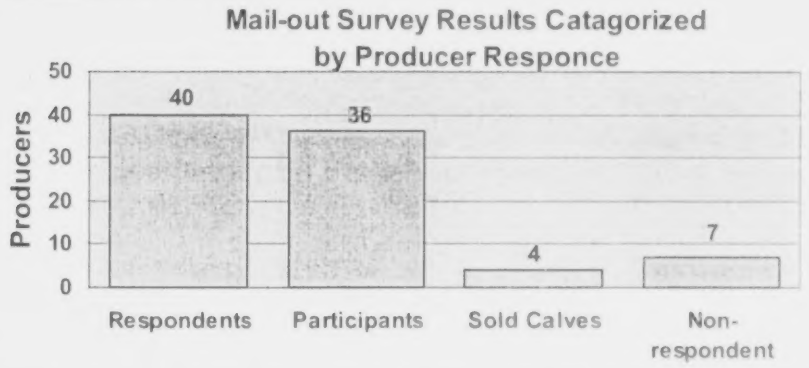


Figure 12 Categorization of producer reaction to the mail out questionnaire

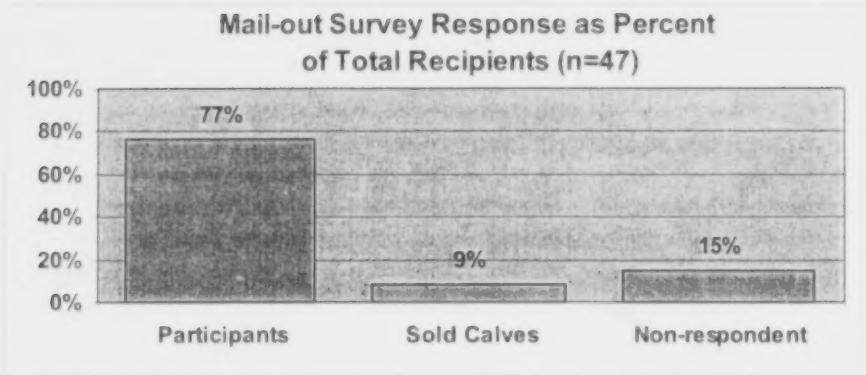


Figure 13 Percent of questionnaire recipients, who are usable for the remainder of the study, responded but were no longer viable and percent of the producers who did not respond to the survey

Discrepancies between responses solicited during the phone survey vs. the mail questionnaire from the same producers were noted. However such discrepancies have been noted in numerous other studies using mixed survey techniques (Dillman 2000). There are three main reasons for discrepancies between the two modes of surveying. The first reason reported by Dillman (2000) is that during interviews there is more personal interaction thereby allowing socially acceptable norms to be an influence leading to culturally acceptable answers. The second reason is that there are two different senses involved between an interview and a questionnaire, leading to different thought processes resulting in alternative interpretations of the question with justifiable responses. The final reason for discrepancies between survey methods is that the interviewer controls delivery of the stimulus, which requires respondent to listen to every word whereas during a questionnaire the respondent has the option of ignoring key parts of the question or response category (Dillman 2000).

Environmental, time and economic pressures also contributed to variations between the two surveys. As with all agricultural operations, production practices must adapt annually to the changing environment. When the initial phone survey was commenced in the fall of 2001 producers felt they would operate as they had done in the past years. However when the mail questionnaire was sent out in the spring of 2002 producers had a better idea of what effect the environment would have on their operations for the year. The year of this study was unique in that there was very little rain in some areas of the province, which influenced the carrying capacity of pasture available for grazing operations. Limited pasture growth forced some producers who usually do not supplement their bison while on pasture to supplement the bison with hay and/or while grazing. The high cost of cereal grains also influenced the length of time bison were expected to be fed grain prior to slaughter.

Mail Survey Summary

The summary of the data collected is based only on the operations of the 36 producers who responded to the mail questionnaire. These 36 producers confirmed that they were still finishing a significant number of bison during the summer of 2002. Each producer was asked a series of questions regarding their bison finishing operation, including topics on herd management, what

the finishing herd is fed, how they judge when their animals are ready for slaughter and where their animals are slaughtered (**Appendix B The Survey**). The first series of questions were used to establish what type of land each producer was finishing the bison on. Soil type and profile will be useful to explain any mineral anomalies that may arise from the liver analysis. The source of any concentrates and forages, which are fed during the finishing period, are also of importance to explain the results of the mineral analysis of the liver. Producers were asked weather or not they fed any imported feeds from outside their home rural municipality (RM). Finding from this show that the majority of producer's use home grown feeds (fig 14), there are also a few producers who import either forage or concentrate or both.

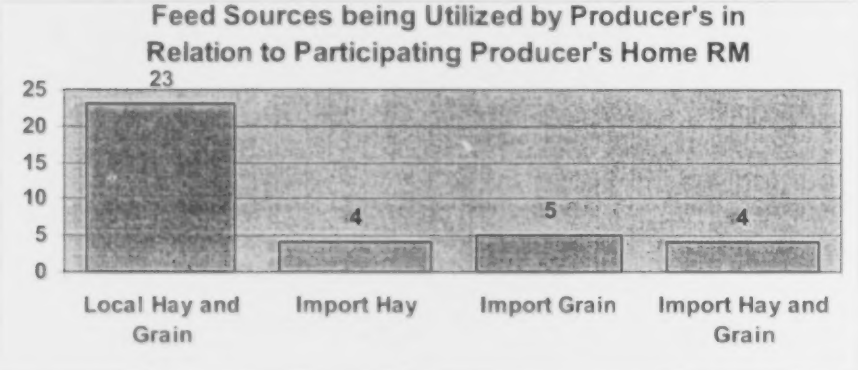


Figure 14 Categorization of the 36 participating producers based on the source of feed for the finishing period in relation to the producers home rural municipality.

Based on the number of producers participating in the remainder of the study it is evident that a large portion of these producers rely on local feeds for their finishing operations (fig 15).

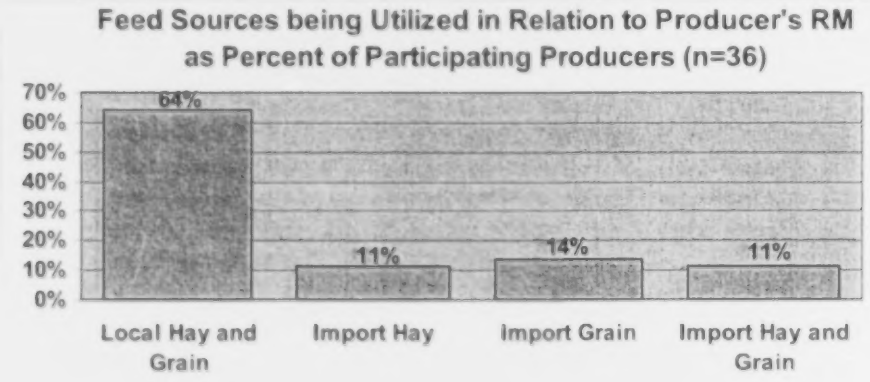


Figure 15 Portion of participating producers who utilize locally grown feeds or import feeds for some portion of the finish-feeding period.

The ability for the bison finishing market to grow in Saskatchewan is reflective in where producers are getting their finishing stock. The majority of producers finish strictly their own

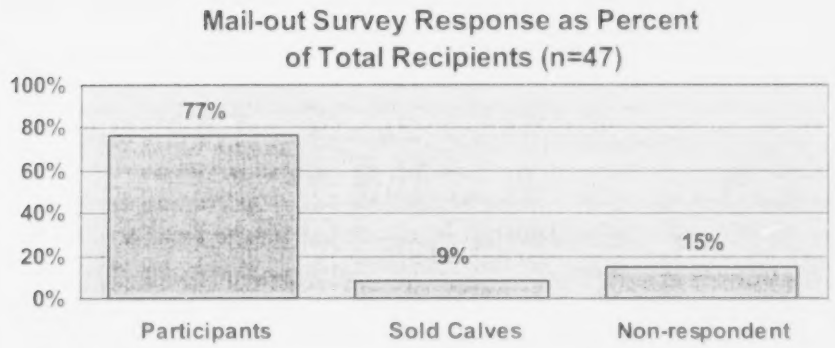


Figure 13 Percent of questionnaire recipients, who are usable for the remainder of the study, responded but were no longer viable and percent of the producers who did not respond to the survey

Discrepancies between responses solicited during the phone survey vs. the mail questionnaire from the same producers were noted. However such discrepancies have been noted in numerous other studies using mixed survey techniques (Dillman 2000). There are three main reasons for discrepancies between the two modes of surveying. The first reason reported by Dillman (2000) is that during interviews there is more personal interaction thereby allowing socially acceptable norms to be an influence leading to culturally acceptable answers. The second reason is that there are two different senses involved between an interview and a questionnaire, leading to different thought processes resulting in alternative interpretations of the question with justifiable responses. The final reason for discrepancies between survey methods is that the interviewer controls delivery of the stimulus, which requires respondent to listen to every word whereas during a questionnaire the respondent has the option of ignoring key parts of the question or response category (Dillman 2000).

Environmental, time and economic pressures also contributed to variations between the two surveys. As with all agricultural operations, production practices must adapt annually to the changing environment. When the initial phone survey was commenced in the fall of 2001 producers felt they would operate as they had done in the past years. However when the mail questionnaire was sent out in the spring of 2002 producers had a better idea of what effect the environment would have on their operations for the year. The year of this study was unique in that there was very little rain in some areas of the province, which influenced the carrying capacity of pasture available for grazing operations. Limited pasture growth forced some producers who usually do not supplement their bison while on pasture to supplement the bison with hay and/or while grazing. The high cost of cereal grains also influenced the length of time bison were expected to be fed grain prior to slaughter.

Mail Survey Summary

The summary of the data collected is based only on the operations of the 36 producers who responded to the mail questionnaire. These 36 producers confirmed that they were still finishing a significant number of bison during the summer of 2002. Each producer was asked a series of questions regarding their bison finishing operation, including topics on herd management, what

the finishing herd is fed, how they judge when their animals are ready for slaughter and where their animals are slaughtered (**Appendix B The Survey**). The first series of questions were used to establish what type of land each producer was finishing the bison on. Soil type and profile will be useful to explain any mineral anomalies that may arise from the liver analysis. The source of any concentrates and forages, which are fed during the finishing period, are also of importance to explain the results of the mineral analysis of the liver. Producers were asked weather or not they fed any imported feeds from outside their home rural municipality (RM). Finding from this show that the majority of producer's use home grown feeds (fig 14), there are also a few producers who import either forage or concentrate or both.

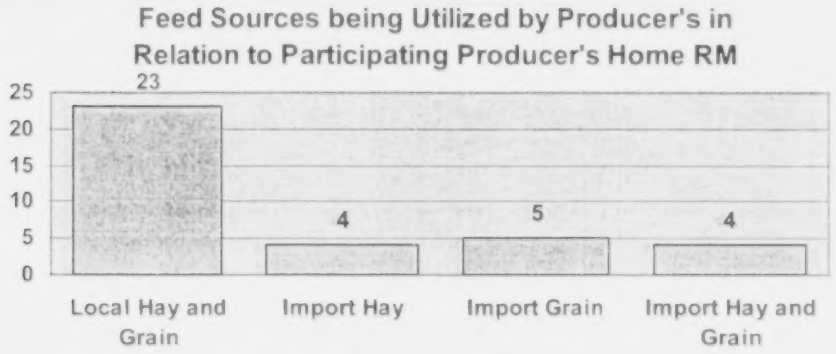


Figure 14 Categorization of the 36 participating producers based on the source of feed for the finishing period in relation to the producers home rural municipality.

Based on the number of producers participating in the remainder of the study it is evident that a large portion of these producers rely on local feeds for their finishing operations (fig 15).

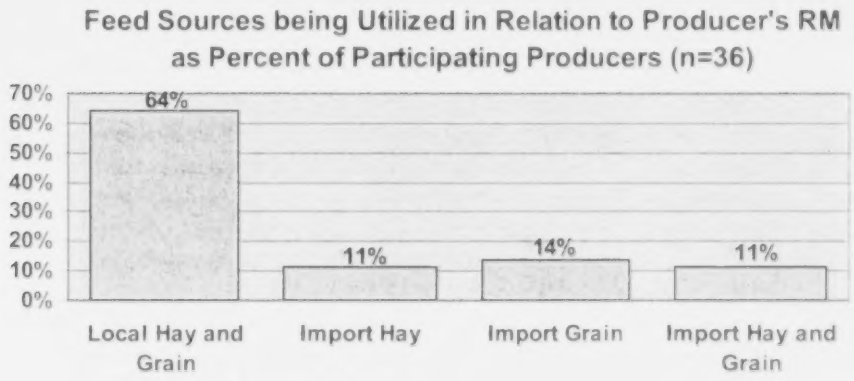


Figure 15 Portion of participating producers who utilize locally grown feeds or import feeds for some portion of the finish-feeding period.

The ability for the bison finishing market to grow in Saskatchewan is reflective in where producers are getting their finishing stock. The majority of producers finish strictly their own

bulls for the meat market. However there is also a significant portion of producers who purchase in extra bulls (fig 16) as well as finishing the bull from their breeding herds. There was only one producer in the study who purchases in all his animals destine for the finishing program. The proportion of producers (fig 17) responding to this study indicate that almost half are buying in extra animals or purchase in their entire finishing herd. Presuming this response group is representative of all the 116 finishing producers in Saskatchewan, the potential to finish all bison born in Saskatchewan is present.

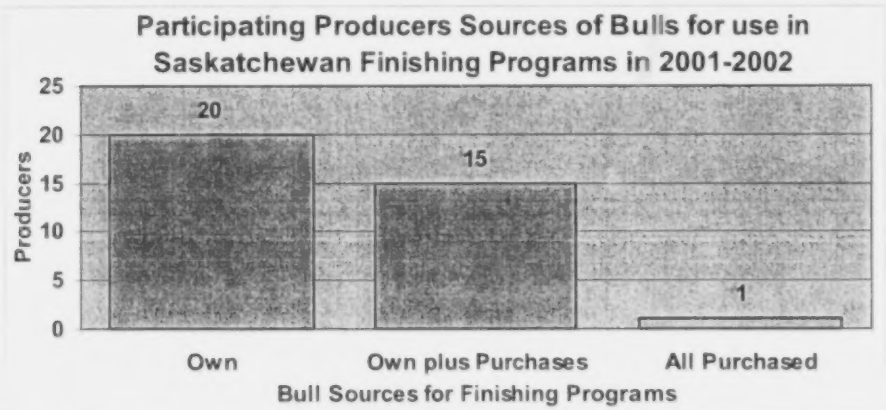


Figure 16 Participating producers categorized by the source of the animals used in their finishing programs

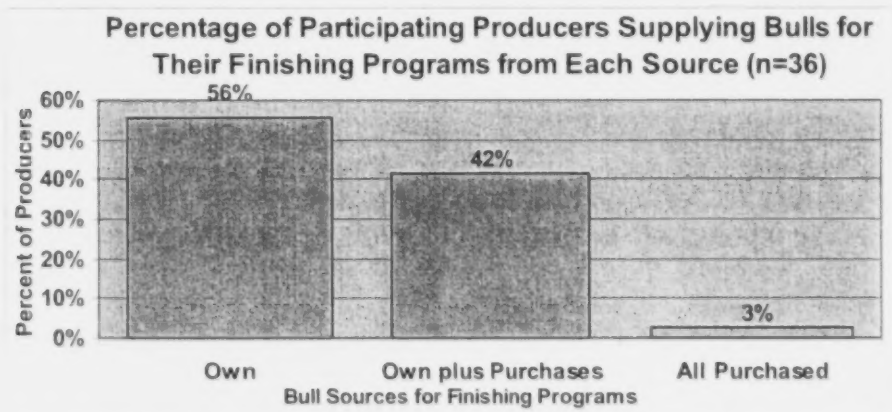


Figure 17 Portions of participating producers sources of bison used in the 2002-2003 finishing period

Responses returned regarding the finishing operations of the participating producers indicated a shift in finishing programs since the fall of 2001. Prior to the mail out questionnaire, bison fed grain for <90 D was the dominant program (Fig. 9). When the questionnaires were analyzed the 50/50 Forage:Grain group increased its number of participants (Fig 18). The <90 D Grain was expanded to <100 D Grain but the number of participants decreased from 29 to 16 (Fig 9). It is

important to note at this point that the single forage finishing producer contributed animals to the forage finishing group, as well as animals to the <100 D Grain group. Data collected from this respondent was treated as if it was managed as one producers operation, but data regarding the bison were treated as two separate operations. Small allowances can be made for the fact that 11 recipients were dropped from the participating pool (Fig. 12), however an obvious shift is present. The proportion of producers that were finishing under the <90 D Grain program shifted from 63% (fig 10) of surveyed producers to 44% of participating producers (Fig 19). The proportion of producers finishing under the 50/50 F:G program increased significantly from initial surveyed expectations. The proportion grew from 20% to 42% of the participating producers finishing under the 50/50 F:G program. The number of producers operating under a feedlot setting decreased slightly but the proportion of producers involved in feedlot operations was roughly equivalent. With the current drought affecting pasture quality, the original strictly Forage finishing producer switched finishing programs as expected given the conditions (fig 18). Luckily a replacement producer was located outside of Saskatchewan and was willing to represent the forage finishing group.

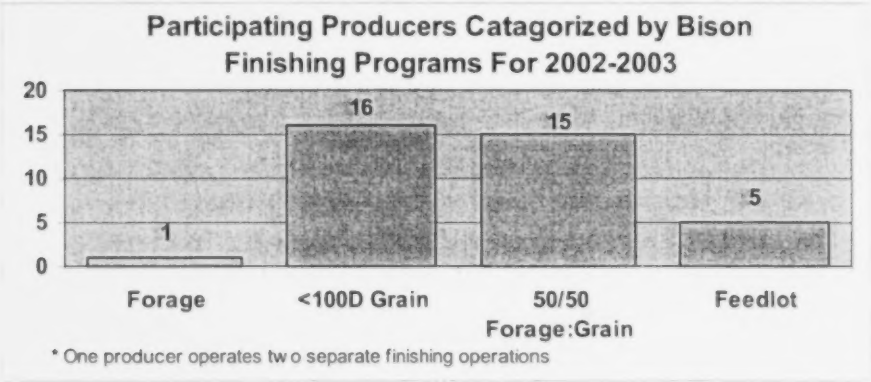


Fig 18 Number of participating producers that are finishing bison under each of the defined finishing programs during the 2002-2003 finishing period

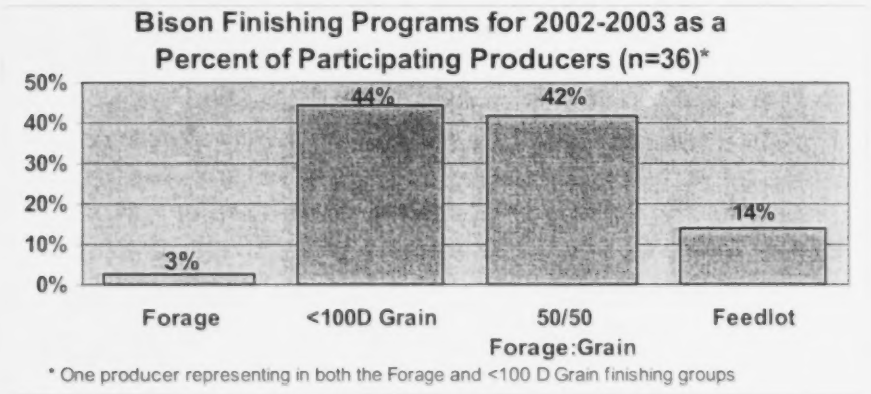


Fig 19 Proportion of participating producers (n=36) finishing bison under each of the defined finishing programs for the 2002-2003 finishing period

bulls for the meat market. However there is also a significant portion of producers who purchase in extra bulls (fig 16) as well as finishing the bull from their breeding herds. There was only one producer in the study who purchases in all his animals destine for the finishing program. The proportion of producers (fig 17) responding to this study indicate that almost half are buying in extra animals or purchase in their entire finishing herd. Presuming this response group is representative of all the 116 finishing producers in Saskatchewan, the potential to finish all bison born in Saskatchewan is present.

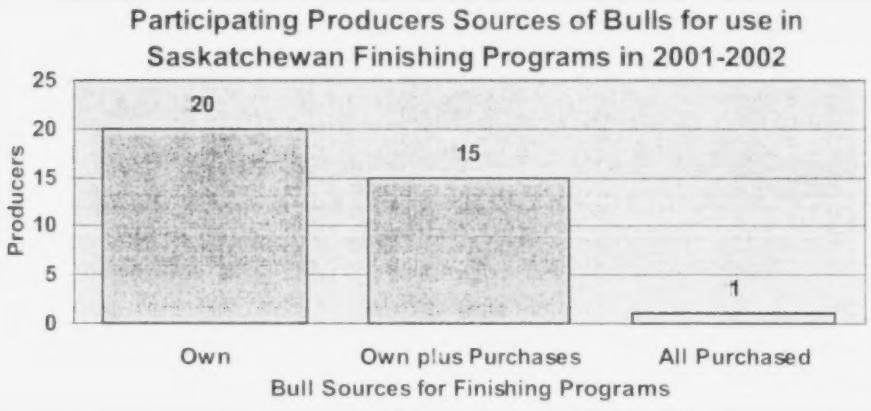


Figure 16 Participating producers categorized by the source of the animals used in their finishing programs

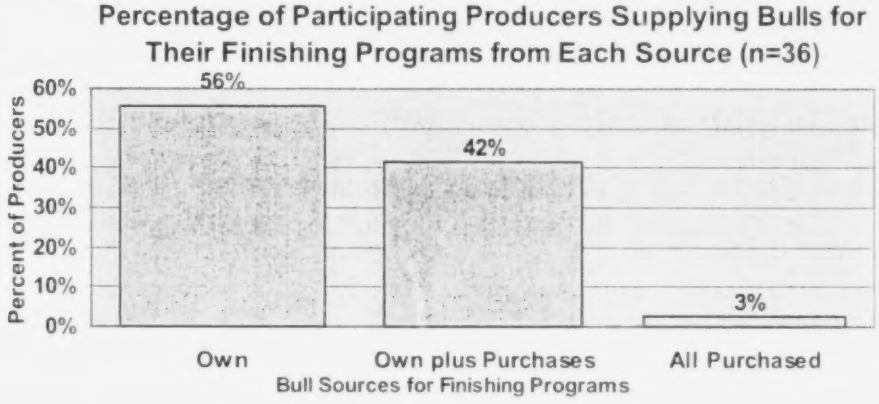


Figure 17 Portions of participating producers sources of bison used in the 2002-2003 finishing period

Responses returned regarding the finishing operations of the participating producers indicated a shift in finishing programs since the fall of 2001. Prior to the mail out questionnaire, bison fed grain for <90 D was the dominant program (Fig. 9). When the questionnaires were analyzed the 50/50 Forage:Grain group increased its number of participants (Fig 18). The <90 D Grain was expanded to <100 D Grain but the number of participants decreased from 29 to 16 (Fig 9). It is

important to note at this point that the single forage finishing producer contributed animals to the forage finishing group, as well as animals to the <100 D Grain group. Data collected from this respondent was treated as if it was managed as one producers operation, but data regarding the bison were treated as two separate operations. Small allowances can be made for the fact that 11 recipients were dropped from the participating pool (Fig. 12), however an obvious shift is present. The proportion of producers that were finishing under the <90 D Grain program shifted from 63% (fig 10) of surveyed producers to 44% of participating producers (Fig 19). The proportion of producers finishing under the 50/50 F:G program increased significantly from initial surveyed expectations. The proportion grew from 20% to 42% of the participating producers finishing under the 50/50 F:G program. The number of producers operating under a feedlot setting decreased slightly but the proportion of producers involved in feedlot operations was roughly equivalent. With the current drought affecting pasture quality, the original strictly Forage finishing producer switched finishing programs as expected given the conditions (fig 18). Luckily a replacement producer was located outside of Saskatchewan and was willing to represent the forage finishing group.

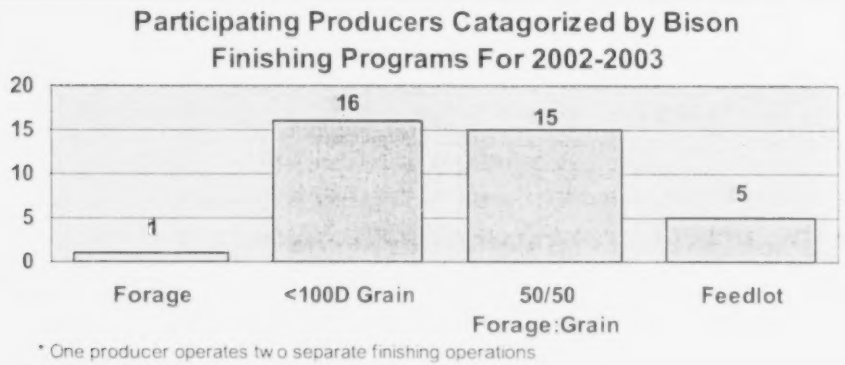


Fig 18 Number of participating producers that are finishing bison under each of the defined finishing programs during the 2002-2003 finishing period

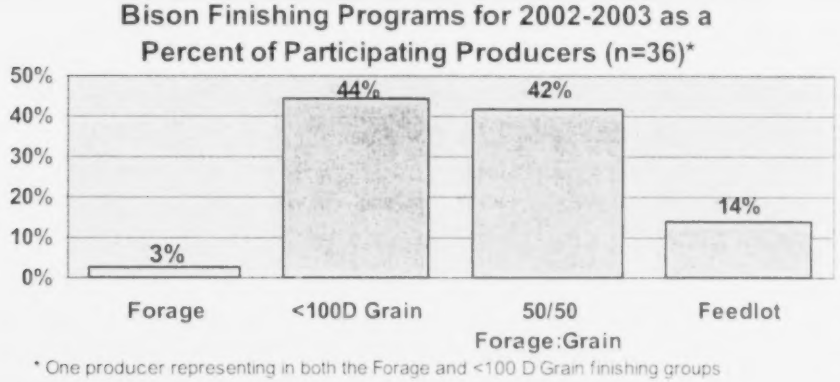


Fig 19 Proportion of participating producers (n=36) finishing bison under each of the defined finishing programs for the 2002-2003 finishing period

Livestock Information

In an effort to control as many variables as possible, which may have an effect on the amount of different fatty acids present, backgrounds of the producers' animals were surveyed. The vast majority of participating producers (83%) have most of their calves born in May (Fig 20). With bison there is a marked reproductive synchrony as a result of seasonal breeding and time of mating during breeding season (Berger 1992). Berger's (1992) work shows that bison cows in good condition during the breeding season, but are bred near the end of the season will shorten their gestation length in order to calve at the same time as the rest of the herd. Research done on domestic beef cows (Piedrafita et al 2000) has shown that no parallel system exists in domestic cattle breeding programs. This birth synchronization characteristic of bison can be contributed to survival instinct in that the main herd will be relatively stationary during the main calving period. Due to the naturally short calving season of bison and the fact that 30 of the 36 participating producers are calving within the month of May, date of birth differences should have minimal impact on the study.

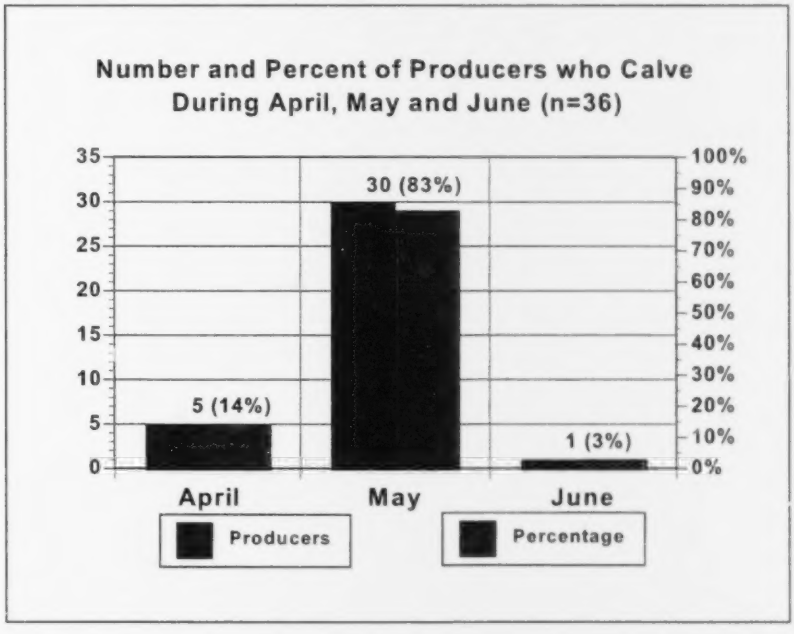


Figure 20 Main calving months for participating bison producers during the 2001 calving season

While the calves are still nursing, the calves are building up body reserves for the winter. A large portion of the participating producers do not creep feed their calves while they are still nursing the cow. However, there are a few producers who do creep feed their calves. One way in which producers can better prepare the calves for the winter is to supply a source of high energy concentrates while on pasture. These concentrates have access limited to only the calves. One of the advantages of creep feeding the calves prior to weaning is so that the calves make an easier transition to the finishing program. These calves that are creep fed will be more adapted to a feedlot setting or a 50/50 Forage:Grain program, in that the calves will identify the feed bunk as a source of feed. Although studies have shown there to be no effect on beef carcass traits

following creep feeding (Drouillard and Kuhl 1999), there were no evaluations of the fatty acid composition of these carcasses. Given the proportion of time animals would be fed creep as compared to the length of time animals spend in the finishing operation, there should be little influence on the overall fatty acid composition of the carcass. However, in an effort be as representative of the bison finishing industry as possible, some creep fed animals were selected for further analysis.

The majority of calves are weaned between November and January (Fig 21), leaving the majority of calves to be weaned between 6 and 8 months of age.

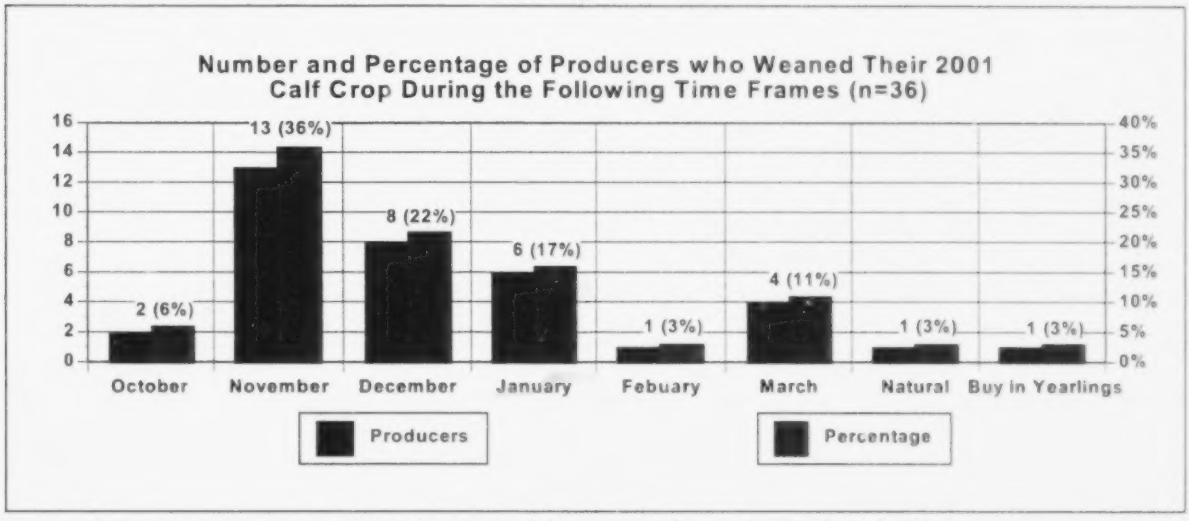


Figure 21 The time frames in which the 36 participating producers begin their finishing operations

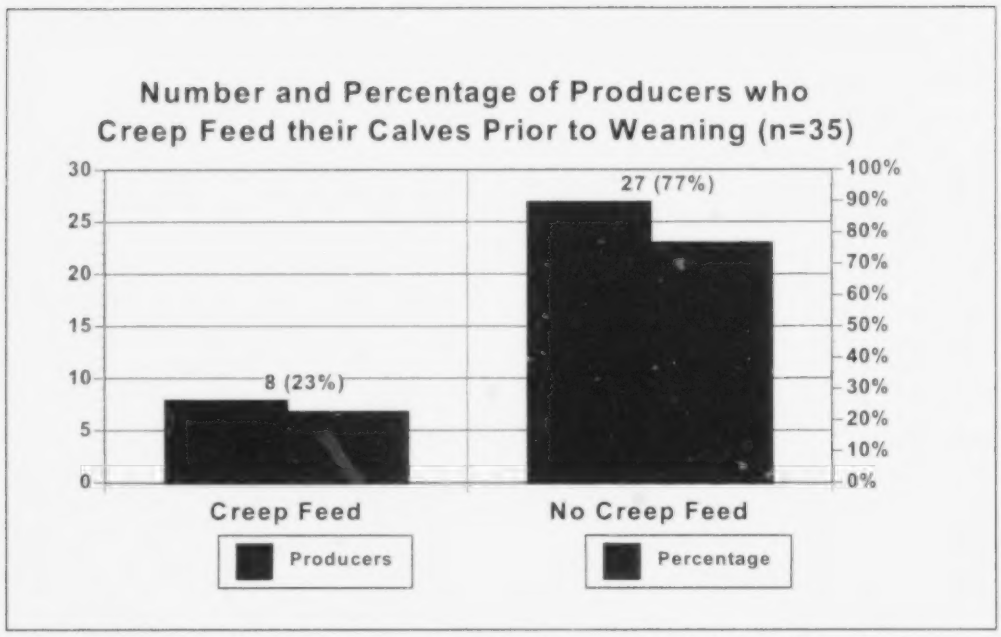


Figure 22 Number of participating producers', who creep feed their calves prior to weaning. Note one producer only purchases yearling for his finishing operation

With the various varieties of creep feed being used by producers, an effort was made to include producers using each of the different varieties of creep feed in the final sample selection and analysis. The lipid content of oats is known to range between 3.5 to 5% and screening pellets are usually 5 to 6% fat. Weather the fat content of these feeds has a direct impact in the final fatty acid composition of the carcass is unknown. In order to judge the influence each of the creep feed types has on the final fatty acid composition, a sample of each concentrate (fig. 23) will be taken an analyzed for lipid content and fatty acid composition. The lipid content of screening pellets may be variable in that the lipid source for pellets comes from a variety of vegetable oils, the majority being canola oil.

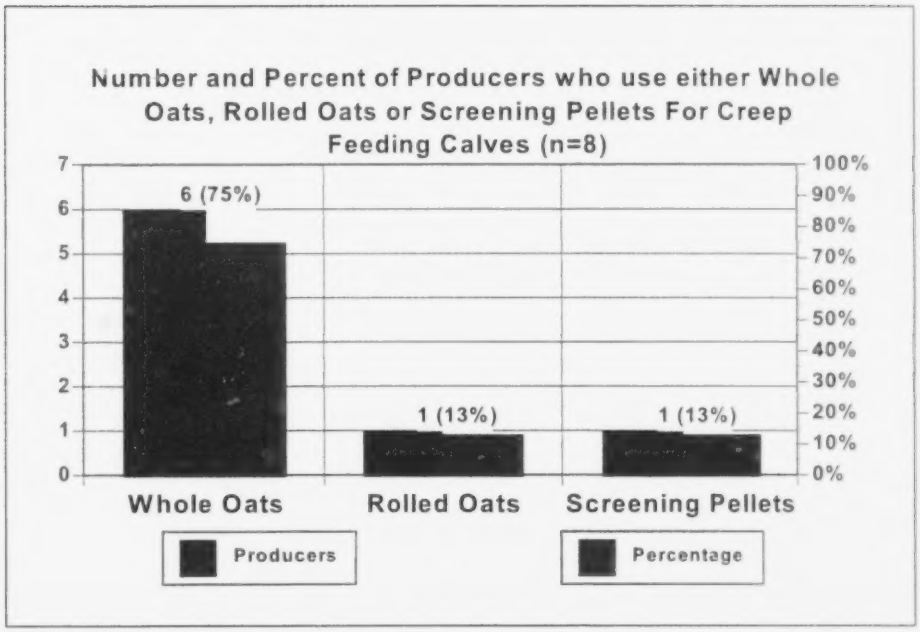


Figure 23 Variety of concentrate sources being utilized by finishing producers to creep feed their calves.

During the mail questionnaire management practices were surveyed in an effort to observe how producers handled the different needs of bison within the finishing program. The first conclusion made from analysis of the data is that space available for finishing operations is a major factor when forming finishing groups. The majority of producers surveyed only make a single finishing group (fig 23) which is comprised only of males. Five of the surveyed producers finish females for the meat market as well. One of these producers feeds the bulls and heifers together. For those producers with available space, finishing animals are broken into same sex groups and if space allows, same weight groups, in order to manage animal requirements more precisely.

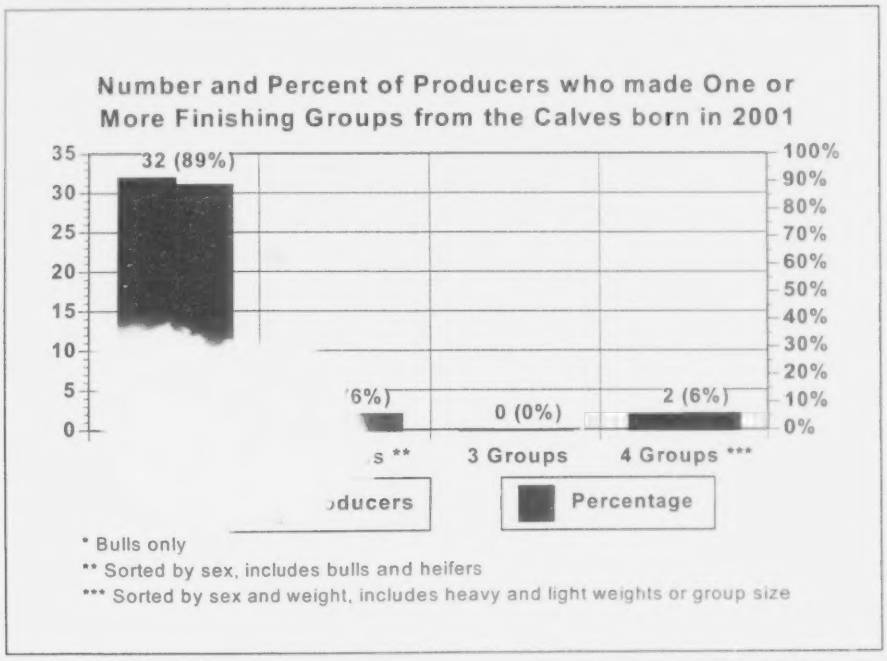


Figure 23 Finishing animal segregation for feeding management of animals finished by surveyed producers.

Another management question posed to the producers was how they determine when to market their animals. In the beef industry, slaughter date is usually determined by average weight of the pen and overall uniformity of the animals. Average weight and uniformity can be related back to the length of time the animals spend on feed. Given that the animals are presorted into uniform groups of similar genetic backgrounds it is expected that each pen will grow at a uniform weight. By gaining at a uniform rate the animals would reach a target weight within a certain time frame. Uniformity of the animals is sought after so that there is little discrepancies between carcasses which enhances the efficiency of today's automated processing lines. Since the bison industry is just emerging in comparison to the beef industry, there are few specialized plants setup to process bison efficiently. This lack of available plants would suggest that animals could be slaughtered at any size being that each animal would have to be handled on an individual size basis. Since bison are such seasonal animals, gain tends to fluctuate with photoperiod and environmental influences. To add to the difficulties of finishing bison, although they are all of the same genetic background individual animal differences will affect daily gain. This creates a difficult management dilemma for producers, in that they can not feed a pen for a set period of time and expect all the animals to be of uniform weight. This requires producers to judge each animal on an individual basis to gauge degree of finish of each animal. Managing the finishing herd like this takes experience through trial and error till the producer is able to judge the degree of finish of animal. Using this technique will result in a producer being able to visually asses the degree of finish of an animal by relating the present animals estimated weight to past finished animals of similar size and their carcass evaluations. Analysis of the data collected from participating producers (fig 24) would indicate that the majority of producers judge the degree of finishing of their animals based on the estimated weight of the animals. The older an animal gets

is often perceived to decrease the tenderness therefore the salability of the carcass. Some producers use this when deciding when to slaughter their animals (fig. 24). One of the problems faced by some bison producers is accessibility to slaughter facilities. In such situations, the producer is subject to the demand of the slaughter plant (Fig 24) or local consumers.

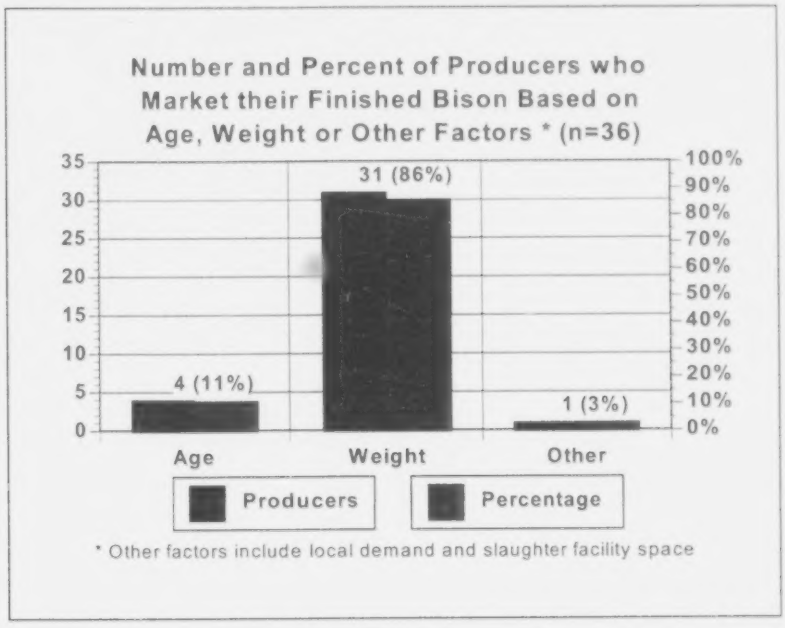


Figure 24 Criteria for determining when participating producers preferred to slaughter finished bison.

The average length of time to finish bison depends on the finishing program. As with cattle, the higher energy content of the diet, the quicker the animal will gain weight. This rule of thumb also holds true for bison, but with some unique species traits. As explained earlier bison go through seasonal growth patterns (Stanton et al). Stanton et al ( ) pointed out that a number of wild ruminants including bison change their endogenous bioenergetic rhythms to adapt to seasonal changes by reducing voluntary feed intake and digestive capacity resulting in reduced growth during the winter months. This seasonal effect is more observable the further the animals evolved from the equator, where the seasonal photoperiod is most perceptible (Stanton et al). The variation in the length of time to finish the bison from the producers participating in the mail survey (fig 25) shows less variation than the responses of the producers who participated in the phone survey (fig 8). The main reason for the variation between the two surveys is due to the number of participants involved. During the first survey only the average of all producers in each group was taken. Where as during the mail survey there was only a fraction of the respondents and the results were cropped to only include those producers who fell within a 95% confidence interval of the mean. Regardless of the number of producers involved in the survey, a more defined time period difference was expected between the Grass group and the Feedlot group (fig 25), as would be found in a beef operation. The more time an animal is exposed to a high energy diet, such as concentrates, the less time it would take the animal to reach finished weight. Therefore a linear regression of slaughter ages should show a steady decline between the

time taken to finish on grass through to the time taken to finish in a feedlot setting. With not all the producers aiming for the same finishing weight, it would be difficult to compare the length of time to reach the same end point under each finishing program. However, based on previous research conducted by Marchello and Driskell (2001), strictly grass finished animals should reach slaughter age in 30 months versus the expected 18 months (Rutley and Hudson 2001) with the other programs falling some where in between.

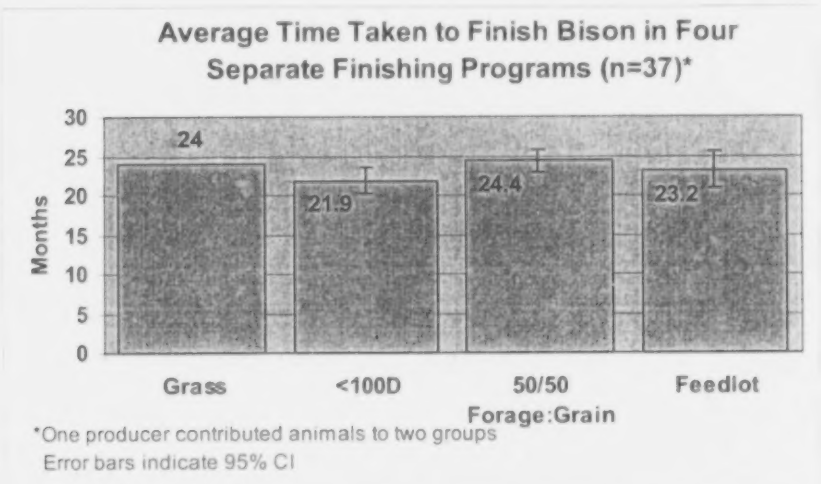


Figure 25 The average length of time taken to finish bison under each of the main finishing program, note error bars indicate a 95% CI of the mean

Live weights of finished bison were taken from producers who have livestock scales and record the live finished weight of their animals just prior to slaughter (fig 26). The average live finished weight of the bison from each finishing group explains the discrepancy seen between the expected finishing length from each group and the actual averaged time length. The Grass finished group slaughters at an average weight of 1050 lbs where as the Feedlot group slaughters at 1190 lbs. Ignoring the seasonal effects on intake, and taking an average daily gain of 0.5 kg/day on grass (Rutley and Hudson), it would take on average an extra

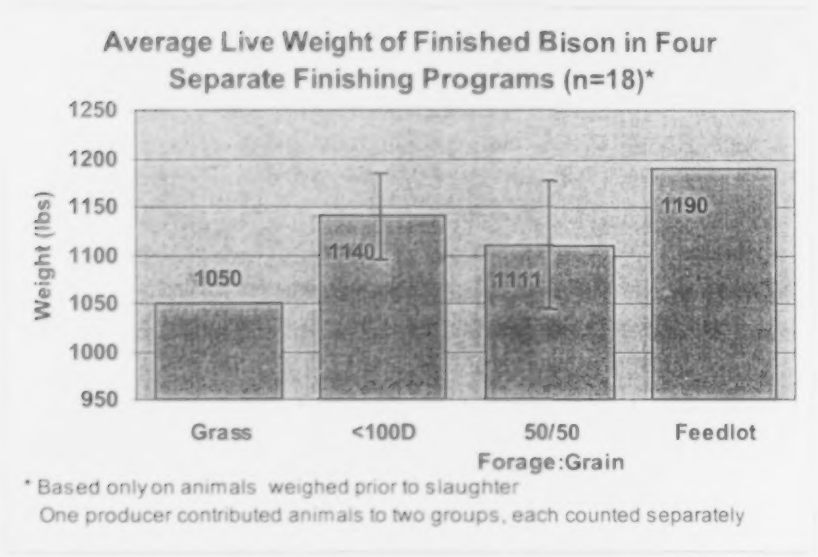


Figure 26

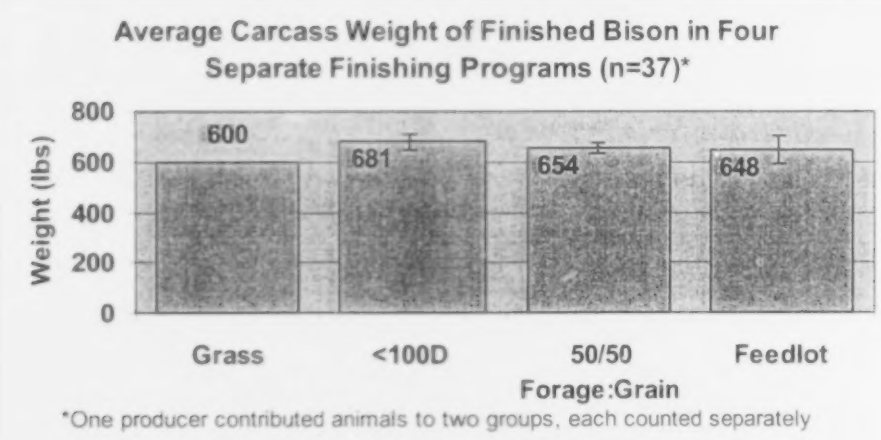


Figure 27

time taken to finish on grass through to the time taken to finish in a feedlot setting. With not all the producers aiming for the same finishing weight, it would be difficult to compare the length of time to reach the same end point under each finishing program. However, based on previous research conducted by Marchello and Driskell (2001), strictly grass finished animals should reach slaughter age in 30 months versus the expected 18 months (Rutley and Hudson 2001) with the other programs falling some where in between.

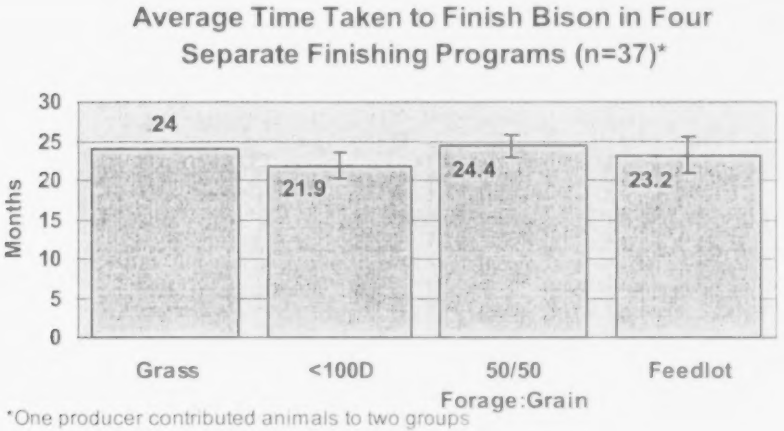
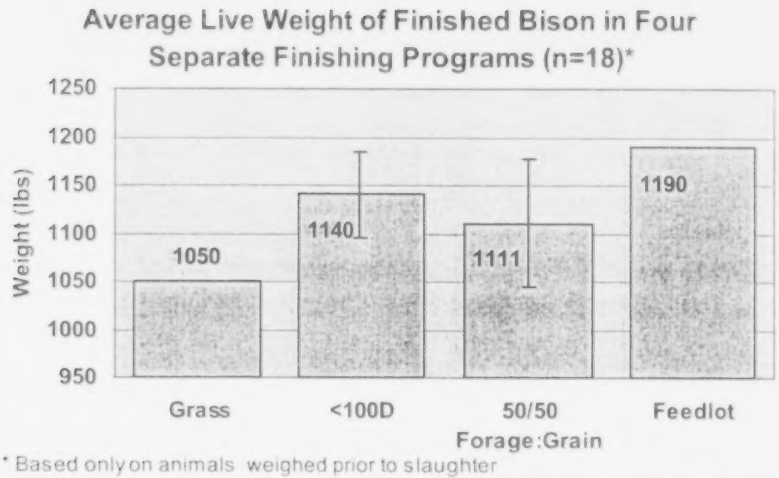


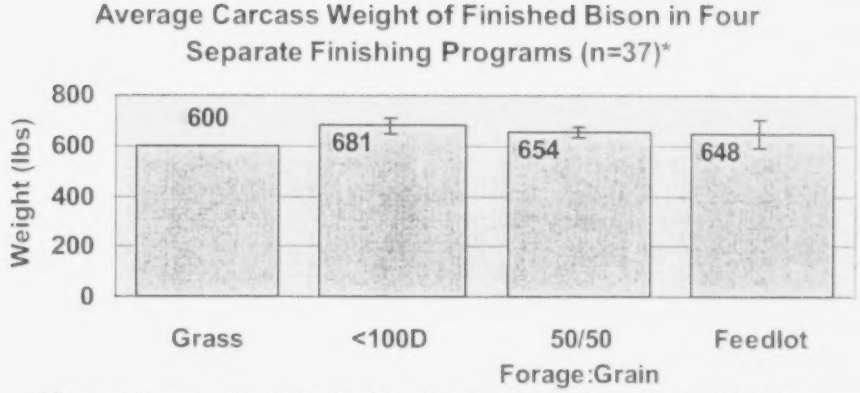
Figure 25 The average length of time taken to finish bison under each of the main finishing program, note error bars indicate a 95% CI of the mean

Live weights of finished bison were taken from producers who have livestock scales and record the live finished weight of their animals just prior to slaughter (fig 26). The average live finished weight of the bison from each finishing group explains the discrepancy seen between the expected finishing length from each group and the actual averaged time length. The Grass finished group slaughters at an average weight of 1050 lbs where as the Feedlot group slaughters at 1190 lbs. Ignoring the seasonal effects on intake, and taking an average daily gain of 0.5 kg/day on grass (Rutley and Hudson), it would take on average an extra



* Based only on animals weighed prior to slaughter
One producer contributed animals to two groups, each counted separately

Figure 26



*One producer contributed animals to two groups, each counted separately

Figure 27

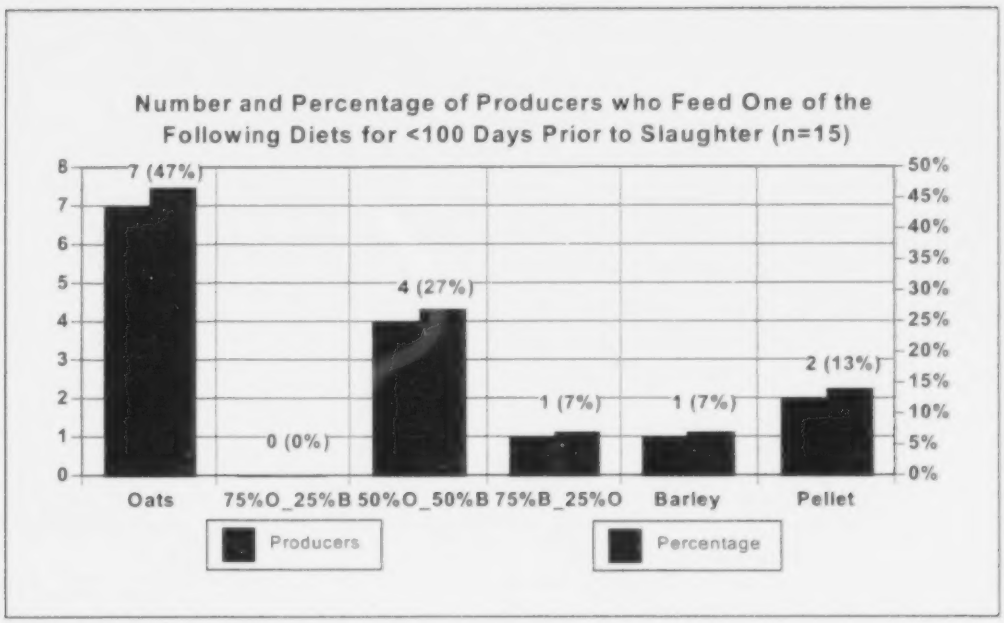


Figure XXXXX

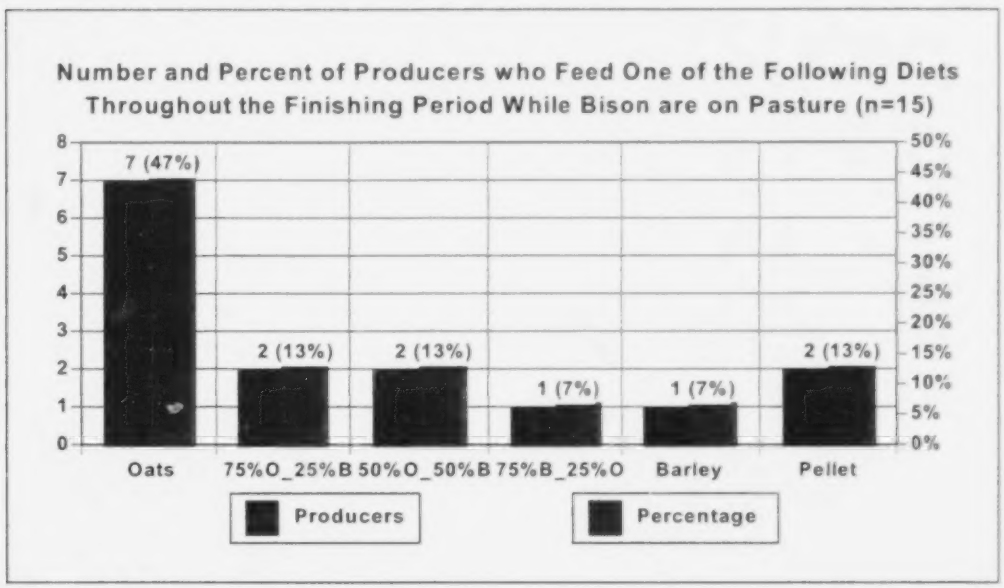


Figure ZZZZZ

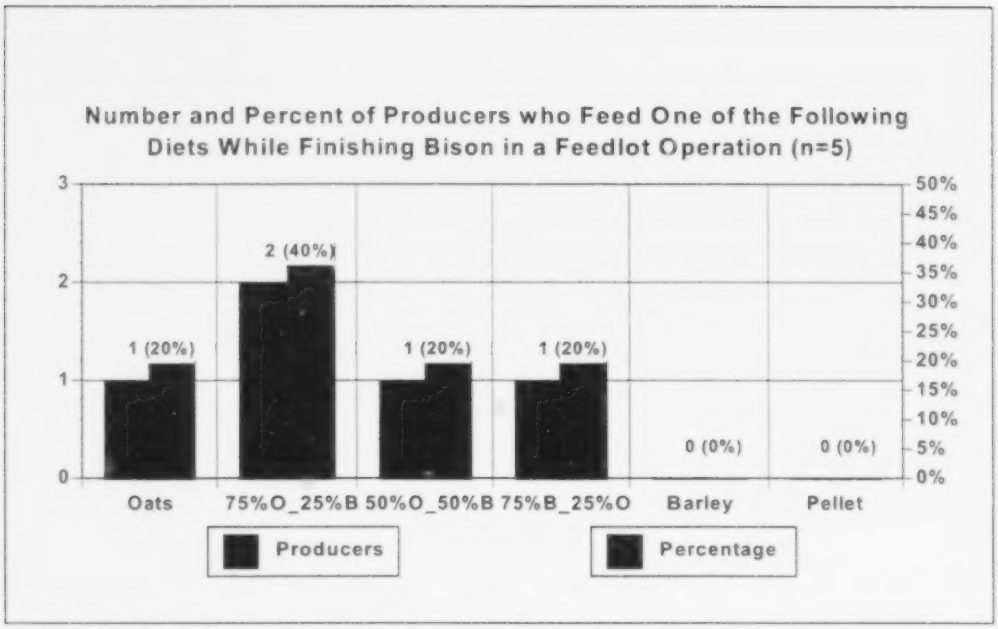


Figure YYYYYYY

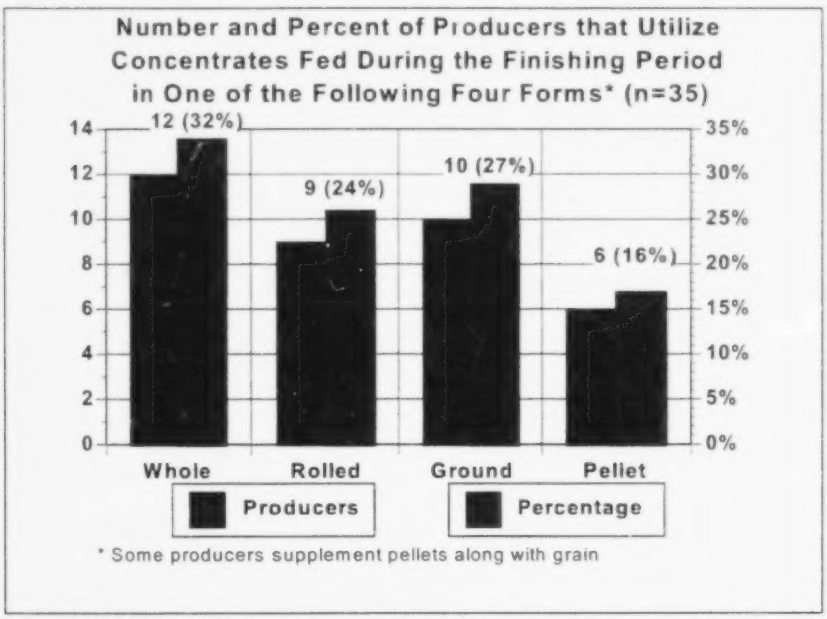


Figure WWWWWWW

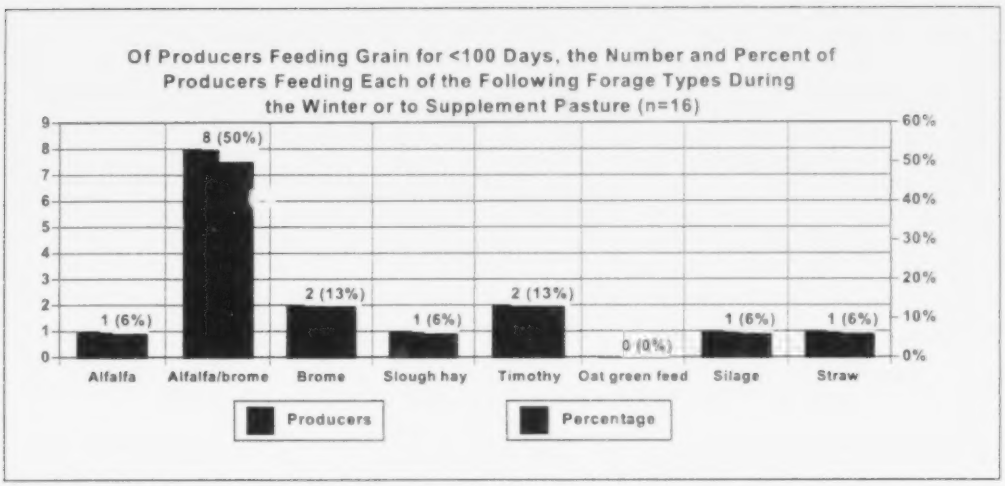


Figure GGGGG

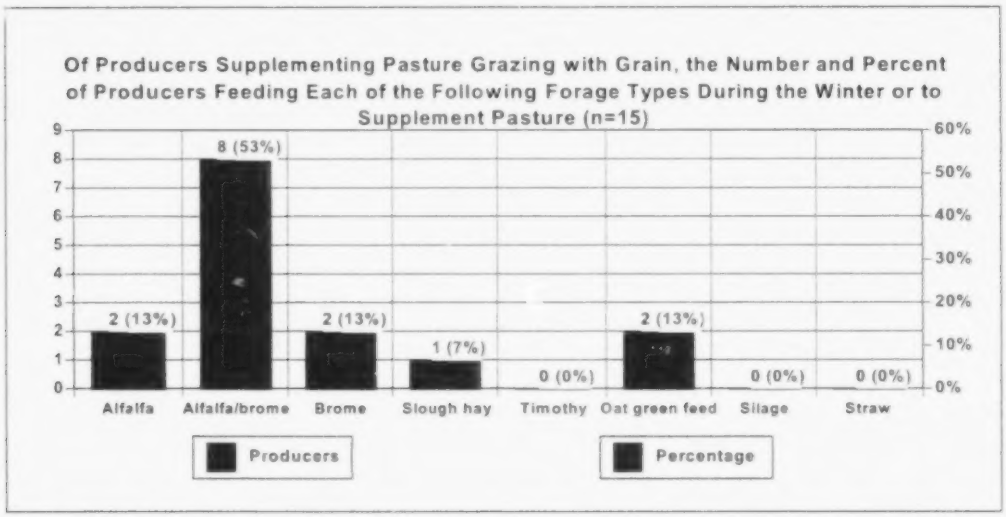


Figure RRRRRR

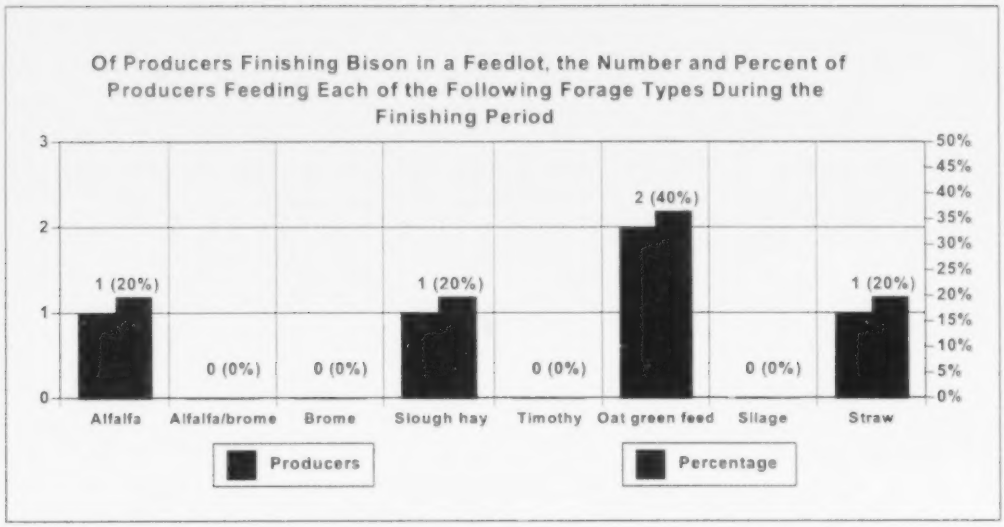


Figure TTTTTT

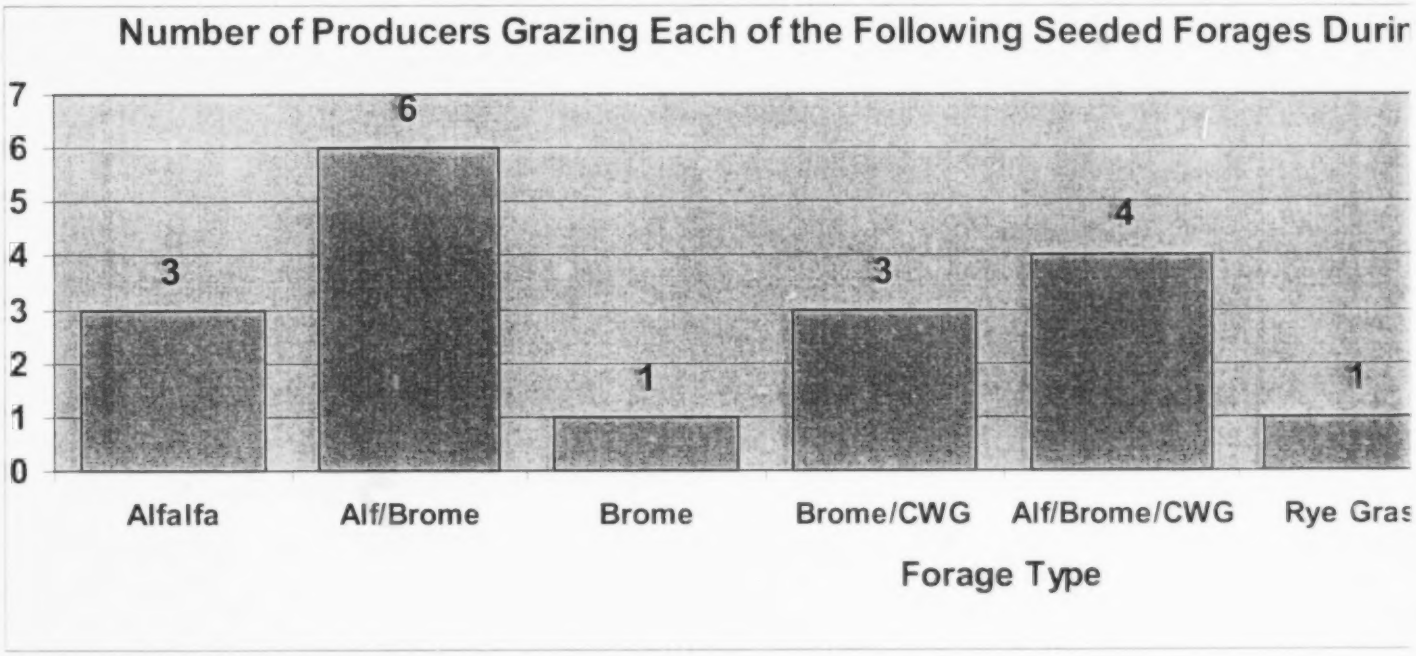


Figure FFFFFF

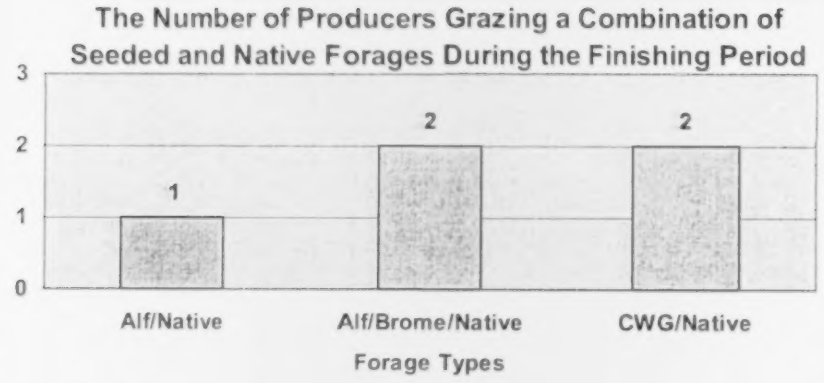


Figure GGGGGG

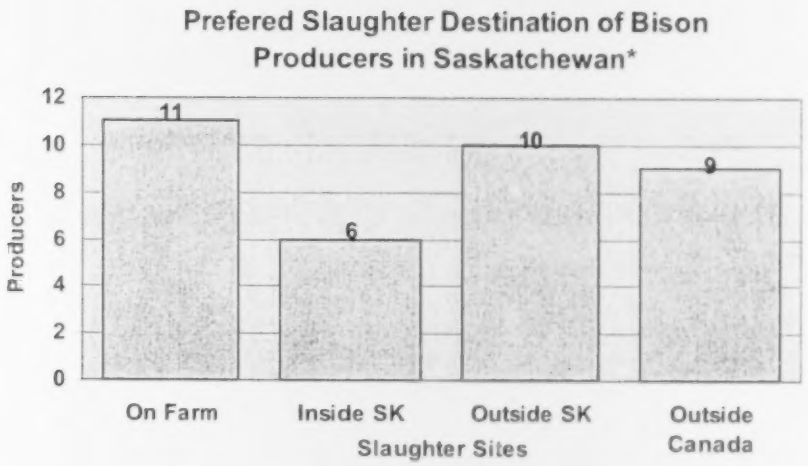


Figure HHHHHHHH

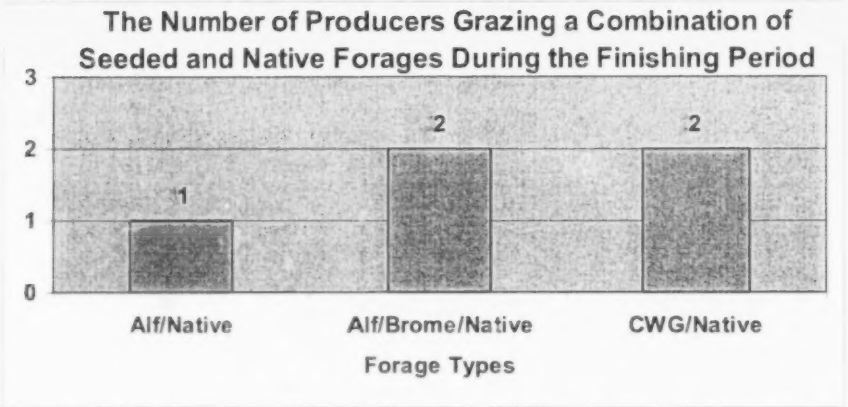


Figure GGGGGG

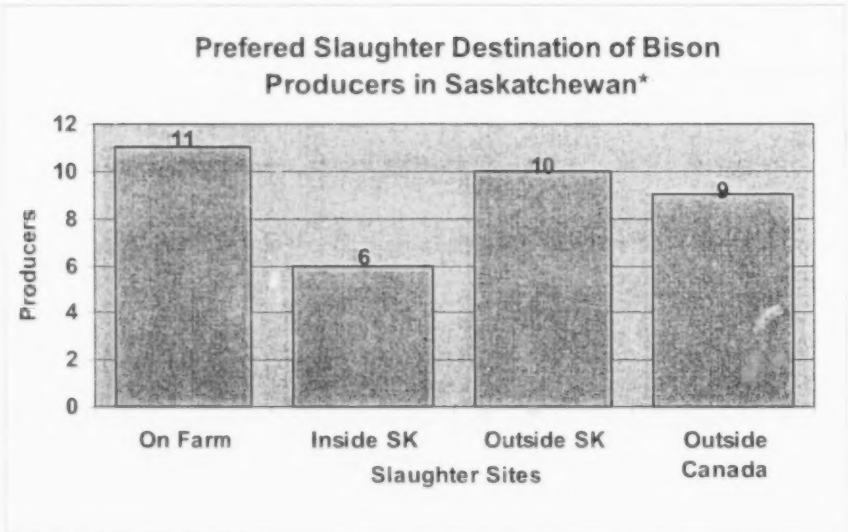


Figure HHHHHHHH

General Questions

Please base your answers on what you did from January 1st, 2001 to December 31st 2001

The expected mineral composition of the feed for most Saskatchewan soil regions is known. To examine the differences in mineral content of bison feed, it is important to know where in Saskatchewan the feed was grown and where your bison are being fed.

1. Please provide the legal land description where your *finishing bison* are located.

   Rural municipality # _____ Land location_____(qtr., sec., tp, R, M)

Please circle your answer below.

2. Was *all* of your feed home grown? **YES** **NO**

3. Did you purchase feed? **YES** **NO**

   If YES to *hay*, which Rural municipality did the *hay* come from?

   If YES to *grain*, which Rural municipality did the *grain* come from?

4. Which definition most accurately describes your Jan1/01 to Dec 31/01 bison operation?

Please circle only **one** letter.

Cow-calf-finisher A: A
All bulls **not** retained as breeding stock are finished as carcass animals, with *extra bulls* bought to be finished.

Cow-calf-finisher B: B
All bulls **not** retained as breeding stock are finished as carcass animals, with *no extra bulls* bought to be finished.

Finisher-producer: C
All bulls are bought specifically to be finished as carcass animals.

5. Do you castrate your bull calves destine for the finishing program? **YES** **NO**

6. Which description below *most* accurately describes your current finishing program?

Please circle only **one** letter.

a. Pasture grazing with hay only and *no concentrates(grain)* in the winter A

until shipping.

b. Pasture grazing with hay in the winter and *less than 100 days on concentrates(grain)* before shipping. **B**

c. Pasture grazing with hay in the winter and *concentrate (grain) supplementation throughout* the finishing period until shipping. **C**

d. Traditional feedlot pens with *no grazing* and concentrates (grain) fed continuously from weaning until shipping with free choice hay. **D**

Calving to Weaning Period

These questions deal with the period between birth and final separation of calf from the cow (weaning).

1. In what month were most of your calves born?

Please circle only **one** letter.

March	**A**
April	**B**
May	**C**
June	**D**
July	**E**

2. Did you creep feed your calves with grain? **YES** **NO**

If NO, skip question # 3, 4 and answer question # 5

3. If you creep feed, how was it done?

Please circle only **one** letter.

Self-feeding **A**
allow bison calves access to as much grain per day as they want

Limit-feeding **B**
allow bison calves to consume only a fixed amount of grain per day

4. If you creep feed, what type of grain was used?

Please circle only **one** letter.

whole oats	**A**
rolled oats	**B**
ground barley	**C**

rolled barley **D**

grain screening pellets **E**

other _____ **F**

5. In what month did you separate the calves from the cows?

Please circle only **one** letter.

October **A**
November **B**
December **C**
January **D**
February **E**
March **F**

Finishing Period

These questions deal with the entire period from removal of the calf from the cow (weaning) to the time the finished bison are shipped for slaughter, or slaughtered on-farm. Please remember to base your responses on what you did in 2001!

1. In September 2001, approximately how many bison intended for slaughter did you have in each of the following age classes?

Calves under 12 months of age (starting finishing program) Male_____

Female_____

12 to 17 mo of age (calves born in 2000) Male_____

Female_____

2. As of March 2002, approximately how many 2000 and 1999 born calves on feed are intended for slaughter before October 2002?

Male_____ Female_____

Each year a new group will enter the finishing program at cow-calf separation (weaning). Larger finishing groups may have to be separated into smaller more manageable groups. The following questions are designed to determine how these finishing groups are divided.

3. How many finishing groups did you make with calves from the 2001 calving season?

_____ **groups**

If you made only one finishing group, skip question #4 and answer question #5.

4. At cow-calf separation, how were the new finishing groups divided? (2001 calves only)
You may circle **more than one** letter.

by age **A**
by sex **B**
by weight **C**
by predetermined group size **D**
(regardless of age, sex, or weight)

5. Did you weigh your calves on a scale at the beginning of the finishing period?

YES NO

If NO go directly to question # 7

6. If you divided groups based on weight, at any time during the finishing period did you move poor-growing heavies into a lighter group?

YES NO

7. If you divided groups based on sex, were the females fed the same diet as the bulls?

YES NO

Slaughter Criteria

Presuming that you could ship the finished animals whenever you decide, the following questions are focused on how you decided your animals were ready to slaughter in 2001.

1. What has been the main basis for determining when your animals are ready to slaughter?
Please circle only **one** letter.

age **A**
weight **B**
other _____ **C**

2. How many months on average from birth to slaughter does it take to finish your bison?

_____ **mos**

3. Did you weigh your finished animals prior to slaughter?

YES NO

4. How many times prior to slaughter did you weigh your finishing bison?

_____ **times**

5. What was the approximate live finished weight for most of your animals in 2001?

male _____ **lbs**

female _____ **lbs**

6. What was the approximate hot carcass weight for most of your animals in 2001?

male _____ **lbs**

female _____ **lbs**

Feeding Practices

These questions examine how you fed your animals during the 2001 finishing period.

1. Which of the following grain or concentrate sources did you use most during the last 100 days of the finishing period?

Please circle only **one** letter

no concentrates	A
only oats	B
mostly oats/some barley	C
half oats/half barley	D
mostly barley/some oats	E
only barley	F
only corn	G
screening pellets _____(type)	H
other_____	I

2. In what form was the *majority* of the grain fed during the finishing period?

Please circle only **one** letter.

whole	A
rolled	B
ground	C
pellet	D

3. What type of harvested forage was most often fed?

Please circle only **one** letter.

alfalfa	A
alfalfa/brome mix	B
clover	C
brome	D
slough hay	E
timothy	F
barley green feed	G
oat green feed	H
silage	I
other_____	J

4. How was the forage presented to the bison?

Please circle only **one** letter.

chopped	**A**
bunk bale feeder	**B**
rolled out on ground	**C**

If your bison DID NOT GRAZE during the finishing period, please go directly to question 9.

5. Did you rotate your finishing bison to different paddocks/pastures while grazing as yearlings?

YES NO

6. If a rotation was used, how many different paddocks did you use for each finishing period?

_____ **paddocks**

7. Which best describes your grazing area?

Please circle only **one** letter.

Native grassland	**A**
Seeded grassland	**B**

8. For your grazing program for animals to be finished, please circle the forage types grazed during the spring to fall finishing period when the animals were yearlings. (April to November as yearlings). In the blank opposite the forage type circled, please indicate the date that the bison began grazing that forage and the length of time (in days) the bison remained on that forage.
If you rotated pastures, in what order were the different paddocks used?

Type	**Grazing Period (#of days)**	**Rotation order**
Alfalfa	_____	
Brome grass	_____	
Crested wheat grass	_____	
Native Prairie	_____	
Rye grass	_____	
Other_____	_____	

Other2_____ _____

Other3_____ _____

9. Did you supply your finishing bison with a mineral source during the finishing period?

YES NO

10. If a mineral source was supplied please include mineral type (i.e. 18:3), brand name, company registration number and a label that includes the contents of the supplement.

Mineral type

Registered brand name

Company reg. No.

11. What feed additives or growth enhancers did you use? You may circle **more than one** letter.

none	A
ionosphores i.e. Rumensin_	B
buffers	C
yeast	D
implants	E
other _____	F

Management Information

1. Did you keep production records such as ADG using recorded animal weights?

YES NO

2. If records were kept, are you willing to make that information available to us?

YES NO

In order to budget for muscle sample collection, it is important to know where the majority of your bison have been or will be slaughtered.

3. Where have the majority of your bison been slaughtered?

Please circle only **one** letter.

a. Slaughtered on farm, processed at local butcher shop **A**
b. Shipped to abattoir *in* SK then slaughtered and processed **B**
c. Shipped to abattoir *in* CANADA, but *outside* SK then slaughtered and processed **C**
d. Shipped to abattoir *outside* CANADA, then slaughtered and processed **D**

4. Where exactly have the majority of your bison carcasses been processed?

Processing facility
City / Town
Province/State
Country

Thank you for your time and patience!

	Table 4. Analysis of Bison Backfat Fatty Acid Composition										
											Pooled
			Grass		<90 D		50:50		Feedlot		SEM
y1	14:0	Myristic	34.37	a	32.94	a	26.92	b	33.01	a	1.42
y2	14:1		1.58	a	1.61	a	1.20	a	1.62	a	0.24
y3	15:0		11.98	a	6.58	a	5.64	a	6.16	a	2.93
y4	16:0	Palmitic	242.02	a	258.37	a	210.14	b	236.05	a	7.90
y5	16:1		34.11	a	32.96	a	31.22	a	30.36	a	1.68
y6	17:0		22.93	a	20.06	a	19.12	a	17.68	a	2.28
y7	17:1		3.62	a	2.86	ab	2.75	b	2.82	ab	0.30
y8	18:0	Stearic	212.05	a	233.23	ab	270.95	c	241.64	b	10.60
y9	18:1 T-6		0.00		0.00		0.00		0.00		0.00
y10	18:1 T-9		5.41	a	1.06	b	1.30	b	0.85	b	0.77
y11	18:1 T-11	Transvaccenic	50.84	a	19.44	b	23.66	b	27.82	b	3.04
y12	18:1 C-9	Oleic	328.88	a	333.46	a	356.93	a	355.96	a	13.11
y13	18:1 C-6		0.00		0.00		0.00		0.00		
y14	18:1 C-11	Vaccenic	7.54	ab	8.74	a	5.41	ab	4.01	b	1.21
y16	18:2 C-9,12	Linoleic	17.18	a	24.85	a	22.17	a	22.64	a	6.59
y17	20:0		2.51	a	2.29	a	5.50	b	3.31	a	0.72
y18	18:3 C-6,9,12	G-linolenic	0.03	a	0.00	a	0.16	a	0.07	a	0.06
y19	20:1 C-11		1.06	a	0.38	b	0.04	b	0.11	b	0.20
y20	18:3 C-9,12,15	A-Linolenic	12.06	a	12.31	a	6.21	b	9.14	ab	1.70
y21	18:2 C9,T-11	CLA	7.85	a	6.55	b	3.88	c	3.86	c	0.42
y22	18:2 T-10,C-12	CLA	0.01	a	0.00	a	0.02	a	0.04	a	0.04
y24	18:2 C10,12	CLA	0.00		0.00		0.00		0.00		0.01
y25	20:2		0.24	a	0.02	a	0.20	a	0.23	a	0.10
y26	22:0		0.00	a	0.00	a	0.00	a	0.00	a	0.06
y27	20:3 n-6		0.60	a	0.43	a	1.79	b	0.51	a	0.42
y28	20:3 n-3		0.08	a	0.03	a	0.07	a	0.09	a	0.05
y29	22:1		0.20	a	0.22	a	0.23	a	0.30	a	0.08
y30	20:4	Arachidonic	0.79	a	1.15	a	1.26	a	1.01	a	2.38

y31	22:2		0.25	a	0.07	a	0.48	a	0.09	a	0.18
y32	20:5	EPA	0.19	a	0.07	a	0.25	a	0.04	a	0.43
y34	22:4		0.13	a	0.03	a	1.03	a	0.10	a	1.24
y35	22:5	DPA	1.35	a	0.29	a	1.41	a	0.46	a	0.88
y36	22:6	DHA	0.13	a	0.02	a	0.07	a	0.05	a	0.28
	means in the same row followed by the same letter are not different, P<0.05										
	Standard Error of the Mean (SEM) also apply to Tables 5 and 6										

Table 5. Analysis of Bison Kidney Fat Fatty Acid Composition

			Grass		<90 D		50:50		Feedlot		
y1	14:0	Myristic	34.49	e	29.51	f	29.90	f	31.99	ef	
y2	14:1		0.55	e	0.47	e	0.47	e	0.88	ef	
y3	15:0		8.94	e	5.73	e	7.20	e	5.65	e	
y4	16:0	Palmitic	240.03	e	243.46	e	222.23	e	231.17	e	
y5	16:1		24.19	e	20.13	e	24.22	e	23.00	e	
y6	17:0		26.00	e	21.72	ef	22.47	ef	19.24	f	
y7	17:1		2.09	e	1.45	e	1.68	e	2.09	e	
y8	18:0	Stearic	323.61	e	379.11	f	370.70	f	301.66	e	
y9	18:1 T-6		0.00		0.00		0.00		0.00		
y10	18:1 T-9		4.17	e	3.06	ef	3.68	e	1.27	f	
y11	18:1 T-11	Transvaccenic	57.38	e	19.29	f	27.19	f	25.82	f	
y12	18:1 C-9	Oleic	229.20	e	220.02	e	247.96	e	310.07	f	
y13	18:1 C-6		0.00		0.00		0.00		0.00		
y14	18:1 C-11	Vaccenic	5.81	e	5.72	e	4.99	e	3.79	e	
y16	18:2 C-9,12	Linoleic	17.19	e	25.65	e	16.40	e	23.03	e	

y17	20:0		4.41	e	4.97	e	7.43	f	4.36	e	
y18	18:3 C-6,9,12	G-linolenic	0.07	e	0.00	e	0.17	e	0.05	e	
y19	20:1 C-11		0.42	e	0.29	e	0.07	e	0.10	e	
y20	18:3 C-9,12,15	A-Linolenic	13.07	e	11.35	e	6.07	f	9.10	ef	
y21	18:2 C9,T-11	CLA	4.45	e	4.15	e	2.49	f	3.49	ef	
y22	18:2 T-10,C-12	CLA	0.01	e	0.03	e	0.04	e	0.03	e	
y24	18:2 C10,12	CLA	0.00		0.00		0.00		0.00		
y25	20:2		0.12	e	0.05	e	0.12	e	0.21	e	
y26	22:0		0.00	e	0.00	e	0.01	e	0.00	e	
y27	20:3 n-6		1.30	ef	1.06	ef	2.05	f	0.76	e	
y28	20:3 n-3		0.08	e	0.03	e	0.07	e	0.12	e	
y29	22:1		0.21	e	0.17	e	0.12	e	0.20	e	
y30	20:4	Arachidonic	0.84	e	1.72	e	0.82	e	1.32	e	
y31	22:2		0.25	e	0.28	e	0.34	e	0.09	e	
y32	20:5	EPA	0.16	e	0.11	e	0.21	e	0.03	e	
y34	22:4		0.05	e	0.13	e	0.22	e	0.08	e	
y35	22:5	DPA	0.89	e	0.34	e	0.66	e	0.38	e	
y36	22:6	DHA	0.03	e	0.00	e	0.02	e	0.03	e	
	means in the same row followed by the same letter are not different, P<0.05										

	Table 6. Analysis of Bison Rib-Eye Fat Fatty Acid Composition										
			Grass		<90 D		50:50		Feedlot		
y1	14:0	Myristic	14.12	x	15.56	xz	12.45	x	18.86	z	
y2	14:1		4.21	x	3.76	xz	3.80	x	3.73	x	
y3	15:0		48.26	x	28.22	z	46.97	x	25.28	z	
y4	16:0	Palmitic	178.96	xz	188.70	xz	173.24	x	199.74	z	
y5	16:1		19.73	x	20.37	xz	19.35	x	24.30	z	
y6	17:0		31.40	x	25.58	xz	43.49	y	21.84	z	
y7	17:1		5.08	x	4.88	x	5.73	x	5.82	x	
y8	18:0	Stearic	126.56	x	136.60	x	130.81	x	140.28	x	
y9	18:1 T-6		0.00		0.00		0.00		0.00		
y10	18:1 T-9		4.23	x	2.97	xz	2.27	z	2.87	xz	
y11	18:1 T-11	Transvaccenic	16.39	x	15.84	x	10.29	x	11.31	x	
y12	18:1 C-9	Oleic	304.79	x	377.74	z	328.90	x	399.22	z	
y13	18:1 C-6		0.00		0.00		0.00		0.00		
y14	18:1 C-11	Vaccenic	21.18	x	19.66	x	21.13	x	19.69	x	
y16	18:2 C-9,12	Linoleic	111.79	xz	95.32	zy	115.20	x	75.07	y	
y17	20:0		1.17	x	2.55	x	1.35	x	1.08	x	
y18	18:3 C-6,9,12	G-linolenic	0.78	y	0.57	zx	0.71	x	0.49	z	
y19	20:1 C-11		0.53	x	0.91	x	0.63	x	0.61	x	
y20	18:3 C-9,12,15	A-Linolenic	30.75	x	16.88	z	14.21	z	11.52	z	
y21	18:2 C9,T-11	CLA	5.06	x	4.69	x	2.29	z	3.12	z	
y22	18:2 T-10,C-12	CLA	0.07	xz	0.00	x	0.11	z	0.00	x	
y24	18:2 C10,12	CLA	0.00		0.00		0.00		0.00		
y25	20:2		1.04	x	1.16	x	1.25	x	0.71	z	
y26	22:0		0.80	x	0.60	zy	0.72	xz	0.46	y	
y27	20:3 n-6		3.59	x	2.26	zy	3.41	xz	1.91	y	
y28	20:3 n-3		0.38	xy	0.21	z	0.49	y	0.27	xz	
y29	22:1		0.78	x	0.68	x	0.34	z	0.35	z	
y30	20:4	Arachidonic	36.55	x	19.69	z	35.60	x	20.34	z	

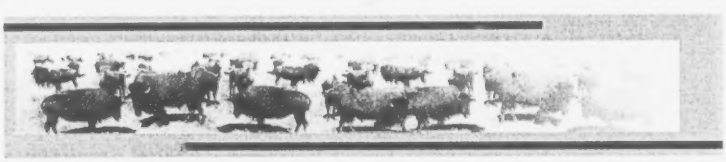
y31	22:2		1.04	x	0.40	z	0.94	x	0.32	z	
y32	20:5	EPA	7.52	x	2.98	z	4.81	y	2.05	z	
y33	24:0		0.11	x	0.62	x	2.58	x	0.36	x	
y34	22:4		1.97	x	1.32	x	5.25	z	1.49	x	
y35	22:5	DPA	16.19	x	6.82	zy	9.19	y	5.25	z	
y36	22:6	DHA	4.96	x	2.47	zy	2.51	z	1.64	y	
	means in the same row followed by the same letter are not different, P<0.05										

Table 3. Bison Kidney Fat (KF) and Back Fat (BF)

milligrams per gram of fatty acids

Fats AA Means*				Bison													
Fatty acid		Grass				<90 Day				50/50				Feedlot			
	Number	19				9				20				12			
		KF	SD	BF	SD	KF	SD	BF	SD	KF	SD	BF	SD	KF	SD	BF	SD
14:0	Myristic	34.49	5.95	34.37	4.52	29.51	6.03	32.94	5.18	29.90	6.07	26.92	6.01	31 99	4.95	33.01	6.27
14:1		0.55	0.18	1.58	0.46	0.47	0.19	1.61	0.64	0.47	0.18	1.20	0.74	0.88	0.66	1.62	1.05
15:0		8.94	3.18	11.98	17.03	5.73	1.59	6.58	1.33	7.20	1.22	5.64	1.25	5.65	1.43	6.16	1.66
16:0	Palmitic	240.03	22.33	242.02	14.45	243.46	36.40	258.37	22.34	222.23	41.17	210.14	49.67	231.17	22.79	236.05	22.28
16:1		24.19	3.53	34.11	3.95	20.13	2.30	32.96	5.13	24.22	4.54	31.22	7.93	23.00	6.69	30.36	7.72
17:0		26.00	3.68	22.93	2.52	21.72	3.13	20.06	1.75	22.47	4.62	19.12	3.09	19.24	2.89	17.68	6.20
17:1		2.09	0.49	3.62	0.43	1.45	0.37	2.86	0.68	1.68	0.39	2.75	1.26	2.09	0.71	2.82	1.22
18:0	Stearic	323.61	28.91	**212.05**	21.61	379.11	36.30	**233.23**	35.54	370.70	33.80	**270.95**	64.71	301.66	60.48	**241.64**	69.30
18:1 T-6		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18:1 T-9		4.17	1.57	5.41	1.45	3.06	3.15	1.06	1.27	3.68	4.59	1.30	2.18	1.27	1.56	0.85	1.28
18:1 T-11	Transvaccenic	57.38	13.04	50.84	13.03	19.29	6.87	19.44	4.83	27.19	14.64	23.66	15.20	25.82	13.75	27.82	11.52
18:1 C-9	Oleic	229.20	29.64	**328.88**	23.86	220.02	26.77	**333.46**	37.41	247.96	25.86	**356.93**	51.08	310.07	52.97	**355.96**	56.35
18:1 C-6		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18:1 C-11	Vaccenic	5.81	2.48	7.54	3.26	5.72	2.11	8.74	4.08	4.99	2.73	5.41	3.67	3.79	1.64	4.01	1.38
18:2 C-9,12	Linoleic	17.19	7.13	17.18	6.09	25.65	8.78	24.85	8.03	16.40	4.10	22.17	30.02	23.03	7.31	22.64	5.73
20:0		4.41	0.95	2.51	0.57	4.97	2.71	2.29	1.10	7.43	3.95	5.50	5.70	4.36	0.90	3.31	1.46
18:3 C-6,9,12	G-linolenic	0.07	0.09	0.03	0.07	0.00	0.00	0.00	0.00	0.17	0.24	0.16	0.24	0.05	0.05	0.07	0.02
20:1 C-11		0.42	0.13	1.06	1.97	0.29	0.13	0.38	0.20	0.07	0.16	0.04	0.05	0.10	0.08	0.11	0.08
18:3 C-9,12,15	A-Linolenic	**13.07**	5.07	**12.06**	3.35	11.35	4.93	12.31	5.59	**6.07**	2.20	**6.21**	2.28	9.10	4.51	9.14	4.43

18:2 C9,T-11	Main CLA	4.45	0.61	**7.85**	1.77	4.15	1.53	6.55	1.77	2.49	0.90	3.88	1.71	3.49	2.31	3.86	2.33
18:2 T-10,C-12	CLA	0.01	0.02	0.01	0.04	0.03	0.06	0.00	0.00	0.04	0.11	0.02	0.09	0.03	0.05	0.04	0.06
21:0		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18:2 C10,12	CLA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20:2		0.12	0.10	0.24	0.12	0.05	0.08	0.02	0.06	0.12	0.09	0.20	0.23	0.21	0.11	0.23	0.11
22:0		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.05	0.00	0.00	0.00	0.00	0.00	0.00
20:3 n-6		1.30	0.61	0.60	0.40	1.06	0.68	0.43	0.21	2.05	1.99	1.79	3.34	0.76	0.24	0.51	0.34
20:3 n-3		0.08	0.07	0.08	0.08	0.03	0.05	0.03	0.08	0.07	0.08	0.07	0.07	0.12	0.08	0.09	0.04
22:1		0.21	0.12	0.20	0.15	0.17	0.14	0.22	0.10	0.12	0.13	0.23	0.39	0.20	0.10	0.30	0.62
20:4	Arachidonic	0.84	0.64	0.79	0.46	1.72	1.73	1.15	0.68	0.82	0.74	1.26	1.49	1.32	1.17	1.01	0.75
22:2		0.25	0.23	0.25	0.20	0.28	0.17	0.07	0.09	0.34	0.62	0.48	1.00	0.09	0.05	0.09	0.07
20:5	EPA	0.16	0.13	0.19	0.18	0.11	0.07	0.07	0.07	0.21	0.42	0.25	0.59	0.03	0.03	0.04	0.03
22:4		0.05	0.05	0.13	0.19	0.13	0.17	0.03	0.05	0.22	0.48	1.03	2.48	0.08	0.04	0.10	0.03
22:5	DPA	0.89	0.52	**1.35**	1.13	0.34	0.29	0.29	0.19	0.66	0.63	1.41	2.59	0.38	0.16	0.46	0.14
22:6	DHA	0.03	0.05	0.13	0.11	0.00	0.00	0.02	0.06	0.02	0.03	0.07	0.09	0.03	0.04	0.05	0.04
	sum	1000		1000		1000		1000		1000		1000		1000		1000	



Effect of Forage and Concentrate Diet Levels on Fatty Acid Composition of Bison Meat

Tyler Turner
M.Sc. candidate
February 4, 2002

Outline

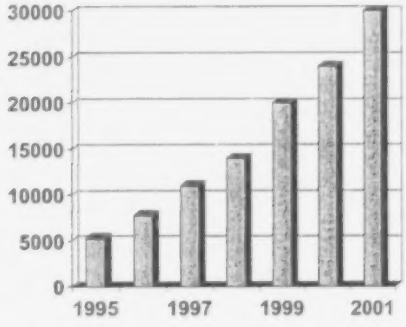
- Introduction-
  - How big is the SK bison industry
  - What's the bison advantage
  - What influences fatty acid levels in diets
- Objectives- How the finishing program affects the carcass fatty acid composition
- Procedure- How are samples selected

Outline

- Analysis-
  - Lipid extraction using Folch method
  - Samples analyzed with gas chromatography
- Expected Conclusions
  - Bison trials will be compared to beef trials using similar diets
- Questions

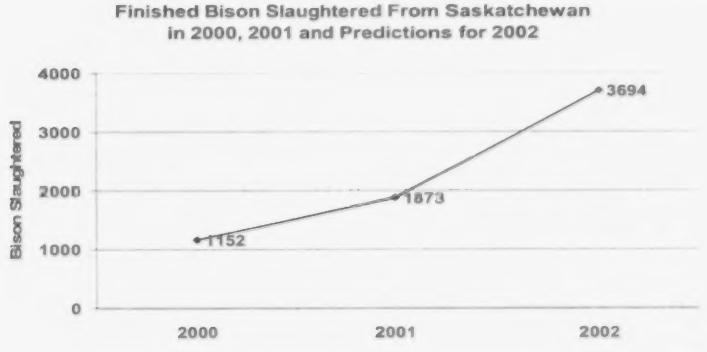
Saskatchewan Bison Herd

- In 2000
  - 24,000 animals
  - 21.3% of Canadian population
- Currently 30,000 animals



Adapted from SAF 2001

Saskatchewan Bison Herd



Bison Advantage

- Bison marketing based on health benefits
  - Low marbling
  - Low cholesterol red meat
  - High protein
  - Good source of iron and zinc
  - Naturally raised

Bison Advantage

- Today's consumers are:
  - Health conscious
  - Informed
  - Concerned with types of fat in meat
  - Concerned with animal welfare

Introduction

Meat	Bison*	Beef**	Pork**	Chicken**
Fat	2 g	6 g	5 g	3 g
Calories	145	160	165	107
Protein	22 g	22 g	22 g	24 g

- 100 gram/ trimmed/skinless/ raw portions
- * Marchello study, North Dakota State University, 1996
- ** Health and Welfare Canada Nutrient File, 1990

Taken from http://www.bisoncentre.com/consumer_corner/nutritional_benefits/index.html

Fatty Acid Influencers

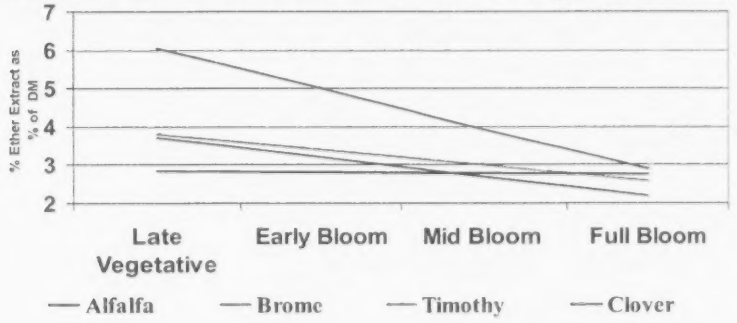
- Finishing program influences the fatty acid composition of the meat
- Concentrate levels in diet affects Fatty Acid (FA) composition
- Increasing n-6:n-3 FA ratios with prolonged concentrate use
- Decreasing n-6:n-3 FA ratios with extended forage utilization during finishing

Fatty Acid Influencers

- Green plants are primary source of Ω-3 FA's
- Ω-3 FA's formed in chloroplasts of leaves
- FA composition varies among plant species
- FA levels decrease with maturity

Fatty Acid Influencers

Trends in Ether Extract Deterioration in Four Forages with Maturity



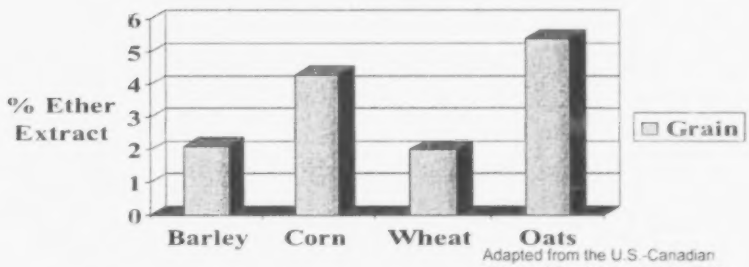
Adapted from the U.S.-Canadian Tables of Feed Composition 1982

Fatty Acid Influencers

- Grain finishing will improve daily weight gain vs. grass finishing programs
- Type of concentrate affects FA profile
- Potential to explore high lipid grains and their effects on carcass composition

Fatty Acid Influencers

Lipid Content of Grain on a DM Basis Determined by Ether Extract Analysis



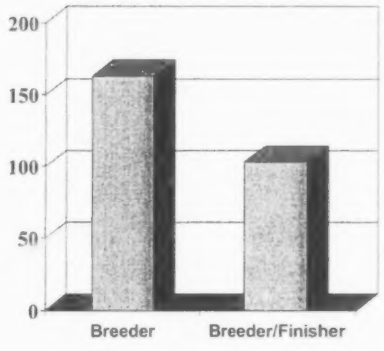
Adapted from the U.S.-Canadian Tables of Feed Composition 1982

M. Sc. Project Objectives

- Identify different finishing programs in SK thru phone and mail-out surveys
- Analyze FA composition of meat
  - Compare meat FA content between different finishing programs
  - Compare meat FA content within each finishing program classification

Survey Procedure

- Identify Saskatchewan bison producers
- Focused management inquiries at target producers

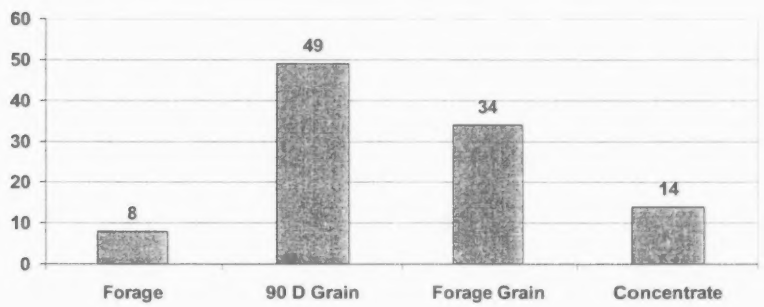


Producer Classification

- Grass finish only
- Grass finish with 90 D concentrate just prior to slaughter
- Grass finish with concentrate supplemented throughout finishing period
- Concentrate finish only

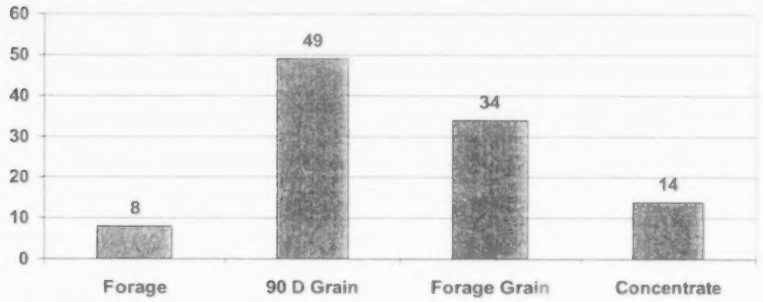
Preliminary Survey Results
Producer Classification

Distribution of Saskatchewan Bison Finishing Producers Within the Four Main Finishing Programs



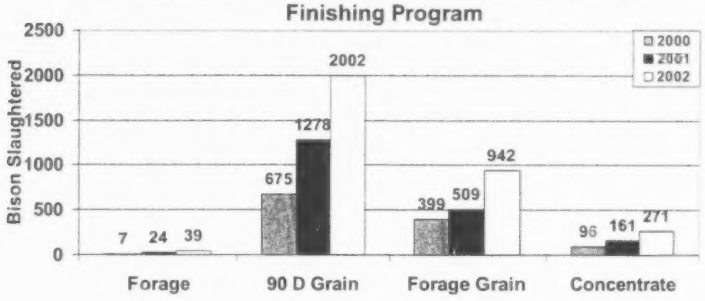
Preliminary Survey Results
Producer Classification

Distribution of Saskatchewan Bison Finishing Producers Within the Four Main Finishing Programs



Preliminary Survey Results
Bison Classification

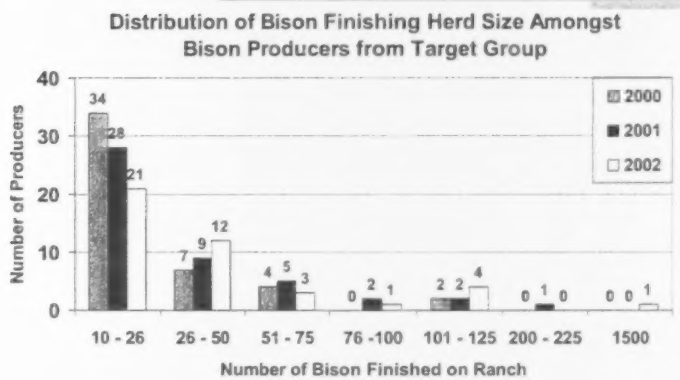
Total Number of Saskatchewan Bison Slaughtered in 2000, 2001 and Predictions for 2002 in Each Major Finishing Program



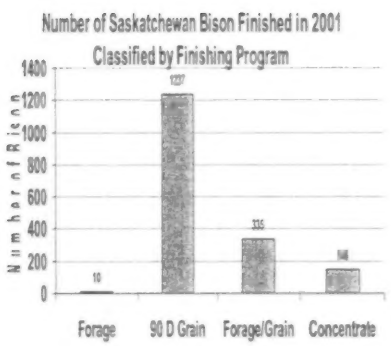
Target Producers

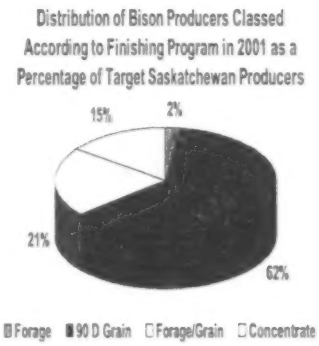
- Willingness to participate in phone survey
- Willingness to participate in mail-out survey
- Must finish 10+ bison per year
- Total of 47 producers selected

Target Group Ranch Size



Bison Sample Groups

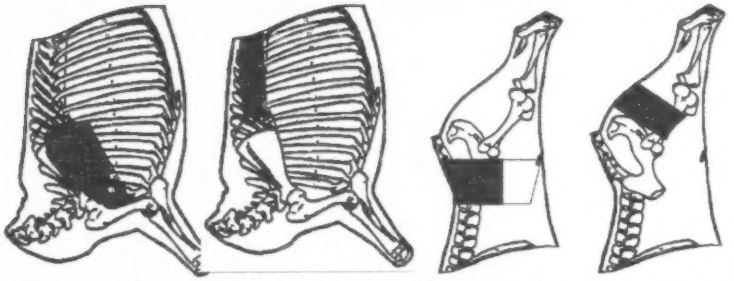




Sampling Period

- Samples will be taken from animals born in 2001
- Collection period depends on finishing length
  - Finished bison range from 18 to 32 months old
  - Sampling will be representative of diets for animals in each group
  - 4 meat samples collected from each animal
  - 2 fat samples collected from each animal

Sampling Sites



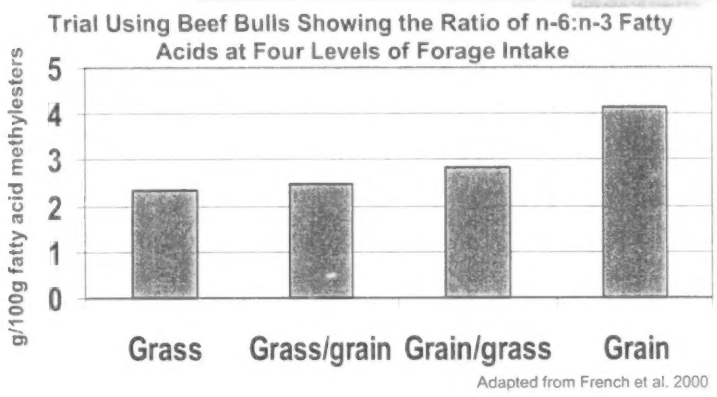
- Top Blade Ribeye Top sirloin Top round
- Kidney knob and subcutaneous fat samples

Taken from http://www.inspection.gc.ca/english/bureau/mcmancv/bbtablee.shtml

Analysis

- **Lipid Extraction**
  - **Using standard Folch method**
- **Gas Chromatography**
  - **Measure from 14:0 to 22:6**
  - **Identify and quantify the FA's present**
  - **Express FA's as a % of total FA's extracted**

Expected Conclusion

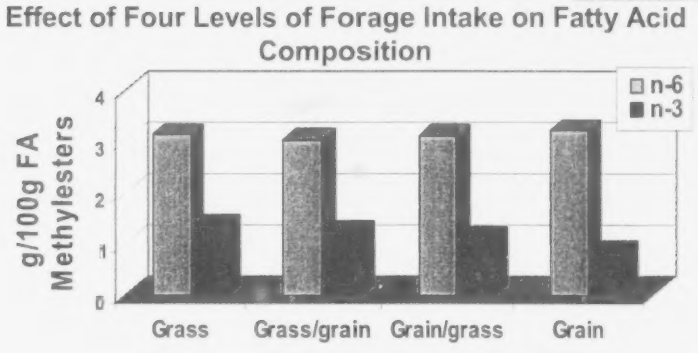


Adapted from French et al. 2000

Expected Conclusion

- Forage increases Ω-3 content
- Forage does not decrease Ω-6 content

Expected Conclusion



Adapted from French et al. 2000

Questions

Bison Finished on Grass

Bison 50:50 Ratio, Forage:Concentrate

Finished 90 Days or More on Concentrate

Feedlot Finished, Carcass Outside

Bison Feedlot Finished, Inside Carcass